DEVELOPMENT AND MAINTENANCE OF STUDBOOKS OF SELECTED ENDANGERED FAUNAL TYPES IN INDIAN ZOOS

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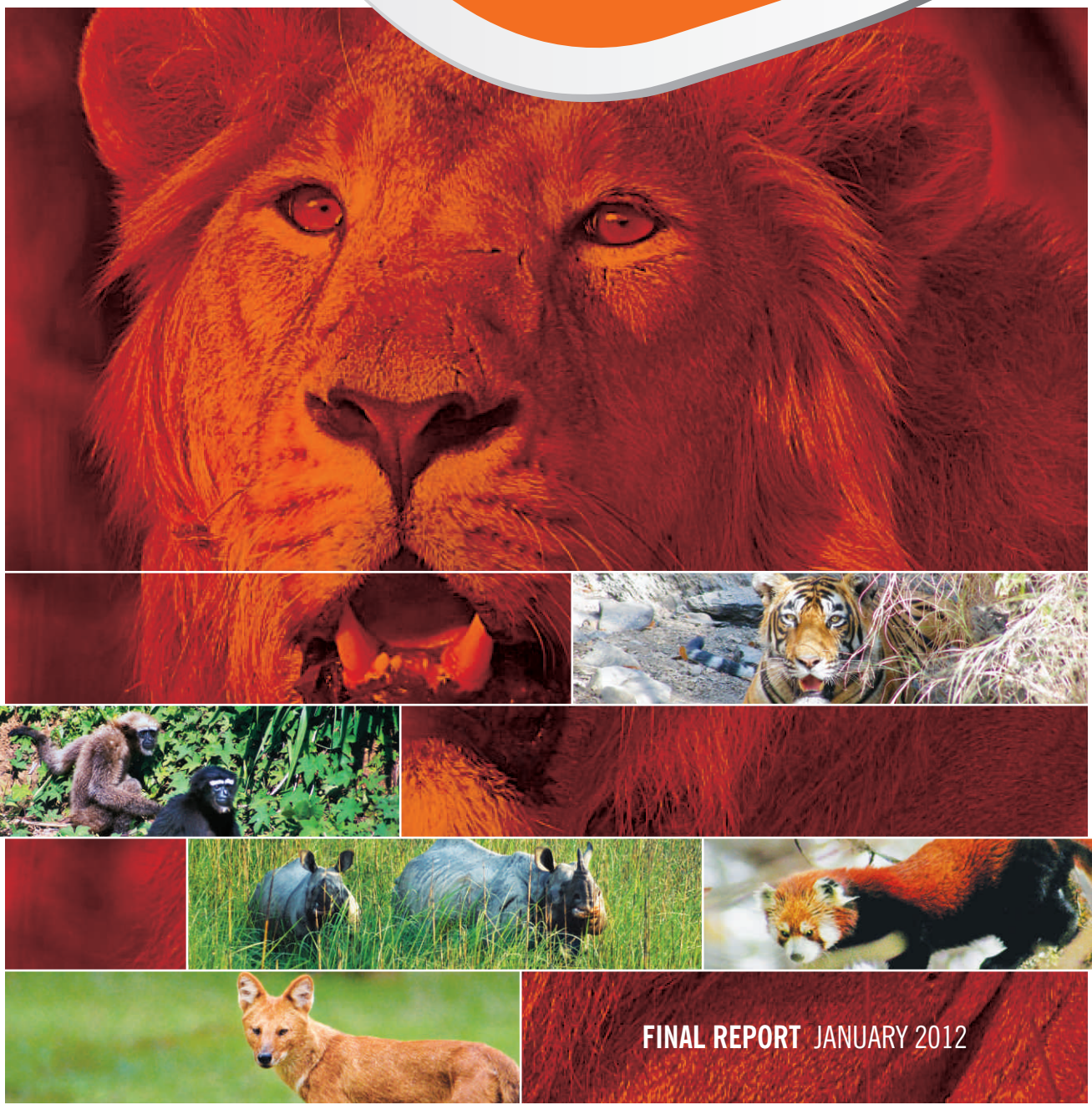
Central Zoo Authority



FINAL REPORT JANUARY 2012

Final Report [January 2012]

Development and Maintenance of Studbooks of Selected Endangered Faunal Types in Indian Zoos

Project Duration :
November 2006 to January 2012

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FOREWORD

The success of any captive breeding program depends largely on the genetic and demographic health of the population. Pedigree data contained in studbooks forms the basis for understanding the genetic and demographic status for the populations. Maintaining stud books is thus a critical requirement for ex-situ management of species.

I have great pleasure in presenting the final report of the project titled Development and maintenance of studbooks of selected endangered faunal types in Indian zoos.

The final report provides a brief account of the studbooks of 14 endangered faunal species held in Indian zoos. The genetic and demographic trends of these species in captivity are briefly discussed. The demographic parameters viz. population size and growth rates, age distribution, mortality and fecundity; and genetic parameters viz. genetic diversity, founder statistics, mean inbreeding coefficient and mean kinship of these species provides an insight into the long term viability of these captive populations.

I hope that the final report prepared under the project would be an initial key step towards scientific management of faunal species in captivity and the wild and complement its *in-situ* conservation.

P. R. SINHA
Director, Wildlife Institute of India
January 2012

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I would like to place on record the vision, commitment and sincere efforts put in by Sh. Debashish Chakraborty and Sh. Anup Nayak as Principal Investigators in the project who had been instrumental in initiating the project. I am thankful to Sh. P. C. Tyagi, Nodal Officer, Captive Breeding and Zoo Management Cell for guidance and help during the project. Thanks are due to Dr. Pradeep K. Malik, Dr. K. Sankar, Sh. B. C. Choudhary, Dr. Sushant Chowdhury, Dr. S. P. Goyal, Smt. Bitapi Sinha, Sh. Qamar Qureshi, Dr. V. P. Uniyal, Dr. Karthikeyan Vasudevan, Dr. K. Sivakumar, Dr. Bivash Pandav, Dr. K. Ramesh and Dr. Bilal Habib for advice and support. Ms. Laurie Bingmann Lackey of ISIS has contributed immensely in the project by providing the SPARKS software and technical inputs in the compilation of studbook; I take this opportunity to acknowledge her effort.

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I am grateful to the zoo directors, biologists, curators and veterinarians from various contributing zoos that have put in effort in sending pedigree information that led to successful and reliable compilation of studbooks. I am grateful to all other individuals directly or indirectly involved during the compilation and maintenance of national studbooks.

Parag Nigam
Principal Investigator
Studbook Project

CONTENT

EXECUTIVE SUMMARY

Introduction

India like the rest of the world is also facing an extinction crisis. Ex-situ conservation of threatened fauna is one of the options being exercised to counter this threat. To meet the challenge of captive management of species threatened with extinction the maintenance of studbooks became a necessity. In view of this in 2006, Wildlife Institute of India was assigned the project titled "Development and Maintenance of Studbooks for Selected Endangered Faunal Types in Indian Zoos" by Central Zoo Authority (CZA) with the objectives to update the four existing studbooks and to initiate studbooks for ten additional species.

Studbooks are the pedigree records of a specific group of animals. It includes information on all animals that have ever lived in captivity and their ancestors in the region, which come under the ambit of that studbook. Each animal is assigned a unique numerical identifier or studbook number that allows for constructing pedigrees for genetic analyses and determination of age of individuals for demographic analyses. The studbook records all the events in the animal's life from birth to death, including the details of time and locations where the animal was transferred. Studbooks; initially developed to manage thoroughbred horses were in the 20th century adapted to managing captive populations of threatened species. Analysis of information contained in studbooks allows for determination of pairing choices (planning mating and transfer of animals to different facilities) to ensure genetic viability. Making of demographic predictions; thereby ascertaining demographic stability of these populations. They also provide data for archival research e.g. identify age/location specific problems.

The project was initiated with the objective of update of existing studbooks of four species and Initiating new studbooks of 10 species. The project also aimed at developing population management plans in captivity for these species.

The methods adopted for carrying out this work involved collection of pedigree data for the identified species from holding zoos. The data collected from various zoos having the species was entered in SPARKS 1.5 (Single Population Record Keeping Software). Preliminary demographic and genetic analysis was carried out using SPARKS 1.5. The data was then exported to PM2000 and detailed demographic and genetic analysis was carried out. The outcomes of these analyses were used to develop population management plan for the captive population of target species. Brief summaries of the 14 studbooks prepared as a part of the project are presented here.

Red Panda

The first studbook that was compiled was that of Red Panda (*Ailurus fulgens fulgens*). Red Panda that has peculiar morphology and specializations to herbivory due to elaborated cheek teeth, especially the premolars, with P2-3 morphology, is a unique carnivore. It is maintained in two Indian zoos. The present living population totals to 22 (17.4.1) individuals and the total number of specimens across time was 66. The analysis revealed that the overall population is growing however; there is a declining population trend for females. The population has moderate levels of gene diversity but both the mean kinship and mean inbreeding were high. These indicators of genetic variability suggest that the population has not retained a large portion of the founder genome diversity and calls for an equitable representation of existing founder genome and the potential founder genome in the population. It is suggested that maintaining the gene diversity at 90% for 100 years requires the addition of one new founder animal annually to the population for next 50 years.

Snow leopard

Subsequently the studbook for Snow leopard (*Uncia uncia*) was compiled. Snow leopard a flagship species of Himalayas is maintained in four Indian zoos with the current population of 21 (12.6.3) individuals. These have been maintained in Indian zoos since 1978 and a total of 51 individuals have been part of the captive population over time. Analysis of life tables reveals a growing population however meaningful predictions could not be made owing to limited sample size. The population has a low level of genetic variability as indicated by low value of genetic diversity retained (GD) and founder genome equivalent (fge). The mean inbreeding coefficient was zero though the mean kinship of the population was high. The analysis suggests that to maintain a genetically viable and demographically stable population in captivity, new founders needs to be added to the captive population and the population size should be increased to at least 100 individuals with equal sex ratio in the period of the next 10 years.

Tibetan Wolf

The details of captive population of Tibetan Wolf (*Canis lupus chanco*) was recorded and analysed. Tibetan Wolf, earlier considered to be a subpopulation of the Iranian Wolf (*Canis lupus pallipes*), may represent a distinct species (*Canis lupus chanco / laniger*) as suggested by recent molecular genetic studies. Its captive population is currently held in four Indian zoos with a total population of 17 specimens (8.11.0). Since 1990, 49 individuals have been held in captivity in India. The life table analysis suggested that overall population is showing a decline. The demographic trends though might be a result of the small number of known age individuals in the population and might not depict the actual picture. Genetic analysis was not carried out as the ancestry of almost all the individuals could not be traced back to founders (wild caught individuals), thus rendering it difficult to construct meaningful pedigree. The study identified the need of molecular genetic studies to ascertain relatedness of individuals. This information can then be used to make breeding recommendations.

Clouded Leopard

The captive population of another vulnerable felid Clouded Leopard *(Neofelis nebulosa*) was then analysed. Clouded leopards which are nocturnal and solitary predators are very secretive in wild. They are housed in five Indian zoos and the living population of clouded leopard has 25 animals of which 11 animals are of wild origin. The historic population of Clouded Leopard in India consists of 36 (18.16.2) individuals. The demographic analyses revealed that the female population is increasing but growth rates could not be calculated for males as most of them are of unknown age. Further, the life table was based on an extremely small sample size limiting meaningful predictions. The value for founder genome surviving and gene diversity retained indicate moderate levels of genetic variability. Though the mean kinship of the population was high there was no inbreeding i.e. mean inbreeding coefficient of the population was zero. The analysis thus revealed that there is no problem of inbreeding in the current captive clouded leopard population in India. The captive population has a good representation of founder genomes and is thus suitable for initiating a genetically viable and demographically stable population. Based on the study it is envisaged that a target of achieving a population size of 100 individuals with an equal sex ratio spread over 4 or more zoos during the next 10 years would serve the purpose of maintaining the species in captivity for insurance.

Hoolock Gibbon

Hoolock Gibbon (*Hoolock hoolock*) a small arboreal primate is the only ape found in India. It has been placed in monotypic genera *Hoolock* based on differences in anatomy and patterns of sexual dimorphism after several taxonomic revisions in recent past. It is maintained in nine Indian zoos; the current captive population being 40

(18.17.4) while total number of specimens across time is 43 (20.16.7). Analysis of data revealed the population to be stable however as none of the births could be attributed to known age individuals, it was difficult to arrive at any value for the various demographic parameters. The population is retaining low genetic variability as indicated by low values for founder genome surviving and gene diversity retained. Though the mean kinship of the population is quite high yet the mean inbreeding coefficient is zero. The management goals report could not be run in PM2000 as most of the individuals are of unknown age and fecundity of both males and females is very low. Analyses of the captive Hoolock gibbon population thus suggest that it comprises largely of wild origin individuals. The biggest challenge is that the species has a poor breeding history in captivity in Indian zoos though a large number of animals in the population have the potential to contribute their genes.

One horned Rhinoceros

Captive population of One horned Rhinoceros (*Rhinoceros unicornis*) was also studied. The Indian rhinoceros inhabiting riverine grasslands of the Terai and Brahmaputra basins has recovered in wild with its threat perception declining from Endangered to Vulnerable due to strict protection being provided to it in recent decades. It is housed in twelve Indian zoos with the current population of 33 (18.15.0) and the total number of specimens in captivity across time in India being 135 (76.59.0). Analysis of male and female life tables revealed that both populations are declining. The value for founder genome surviving and gene diversity retained indicate high genetic variability in the population. Both the population mean kinship and the mean inbreeding are moderate. Analysis of the captive Indian population thus suggests that the current population has a high level of genetic diversity but is threatened by low numbers. A target population size for Indian zoos of 100 individuals to be achieved over 10 years is suggested for maintaining a genetically viable and demographically stable population. The current population has several animals of wild origin whose genes are not represented or underrepresented in the captive population. A more equitable representation of the founder gene pool would enhance the genetic stability of the captive population.

Indian bison - Gaur

Gaur (*Bos gaurus*) national studbook was also compiled and analysed. Gaur which is vulnerable to various threats including poaching, habitat loss, fragmentation and degradation due to anthropogenic activities, is maintained in nine Indian zoos with the current population of 67 (35.31.1) individuals. Across time the total number of specimens that have been held in captivity in India is 93. Life table data suggest that both the male and the female populations are growing. The value for founder genome surviving and gene diversity retained indicate that the population has moderate genetic variability but both mean kinship and mean inbreeding coefficient are quite high. Modeling the current population for minimum population size required to retain 90% genetic diversity at the end of 50 years and be demographically stable at the same, gave a result of 123 individuals. Analysis of the captive Indian population thus suggested that the current population was initiated with low founder numbers. A target population size for Indian zoos of 150 individuals to be achieved over 15 years; with the inclusion of two founders every year for the same time period is suggested for maintaining a genetically viable and demographically stable population.

Dhole - Asiatic wild dog

Asiatic wild dog (*Cuon alpinus*) is an endangered canid housed in five Indian zoos. The present captive population of thirty-eight specimens consists of ten wild caught individuals and twenty-eight captive born individuals. Across time a total of 41 individuals have been kept in captivity. The analysis suggested that male population is growing while the female is showing a decline. Though attempts were made to carry out genetic analysis using PM 2000, however, the presence of a large number of individuals of unknown ancestry and dates of birth were limitations to analysis. It is

suggested that a molecular genetic analysis to ascertain the parentage/ relatedness of individuals be carried out and based on this analysis the pairings of individuals can be decided upon.

Indian Wild Ass

Studbook of Indian Wild Ass (*Equus hemionus khur*) was compiled. Indian Wild Ass a generalist herbivore occurs as a single population in Little Rann of Kutch (*Wild Ass Sanctuary*) in Gujarat. Two Indian zoos are currently holding these Equids; with a total of 12 (7.5.0) animals in captivity at present. In historical perspective 82 individuals have so far been kept in captivity. An analysis of life tables for males suggested that the population is declining. However, the life table analyses results were limited by low number of known age individuals in the population and hence could not be used for population predictions. The values for founder genome surviving and gene diversity retained indicate that the captive population retains a small part of the genetic variability of the founder population and needs to be intensively managed to maintain a demographically viable and genetically stable population. Moreover both the mean kinship and the mean inbreeding were high. Analysis of the captive population suggested that the species has negative growth rates and low levels of genetic diversity. The captive population is being sustained because of continued addition of wild founders. It is suggested that in order to maintain a genetically viable and demographically stable population, a population size of 176 individuals over the next 20 years is required to be achieved. The maintenance of 90% genetic diversity over the next 50 years can be achieved by the addition of one founder animal each year for the next 50 years.

Grey Peacock Pheasant

Grey Peacock Pheasant (*Polypectron bicalcaratum*) is a galliform characterized by strong sexual dimorphism with the males being highly ornate with bright colours and adornments. In captivity they are maintained in four Indian zoos with the current population of 33 (11.16.6) individuals. A total of 54 individuals have been kept in captivity since 1994. Demographic and genetic analysis of the data was not carried out as the data available from zoos has poor information on the pedigree records and dates of entry and exit of specimens. It is therefore suggested that a detailed parentage analysis of the specimens existing in captivity be carried out using molecular genetic techniques prior to carrying out further breeding.

Asiatic lion

Studbook of Asiatic lion (*Panthera leo persica*); a critically endangered sub-species of lions was compiled. A single wild population is surviving in and around Gir in Junagadh district of Gujarat. In India the species is housed in sixteen zoos and the current population comprises of 154 (73.81) individuals. The total number of specimens across time is 672 (291.328.53). The analysis revealed an increasing population trend for males and a decline for females. In addition, analysis of the captive Indian lion population suggested that the current population retains a large proportion of the genetic diversity of the free ranging population. A target population size for Indian zoos of 162 individuals to be achieved over 10 years is suggested for maintaining a genetically viable and demographically stable population. The current population has several animals of wild origin whose genes are not represented or under represented in the captive population. A more equitable representation of the founder gene pool would enhance the genetic stability of the captive population

Nilgiri langur

The records of Nilgiri langur (*Trachypithecus johnii*) were analysed. Nilgiri langur is a threatened black faced colobine that is endemic to Western Ghats in South India. The species is maintained in four Indian Zoos. The current captive population of Nilgiri Langur comprises 30 individuals while historically 37 (15.19.3) individuals have been kept in

captivity. Detailed demographic and genetic analysis of the data was limited by poor information on the pedigree records; and dates of entry and exit of specimens.

Lion tailed macaque

Captive data of another primate endemic to Western Ghats Lion tailed macaque (*Macaca silenus*) was analysed. The species has been named so because its tail has a tuft of hair at its end similar to that of lion (*Panthera leo*). It is housed in 20 institutions in India and at present in captivity there are 86(44.41.1) individuals. Across time the number of individuals is 256 (113.121.22). Life table for lion tailed macaque revealed that the male population is growing while female population is declining. The population is retaining moderate genetic variability as indicated by the values for founder genome surviving and gene diversity retained. Further both the mean kinship and the mean inbreeding of the population are high. It is suggested that for achieving the genetic management goal of maintaining 90% genetic diversity for 50 years, a population of 150 individuals needs to be maintained with the addition of one founder every alternate year for the next 45 years. This scenario would require the minimal number of founders to be included in the captive breeding program.

Bengal tiger

Finally the pedigree data of Bengal tiger (*Panthera tigris tigris*) was analysed. It is the flagship species for wildlife conservation in India and housed in 49 Indian zoos. There are a total of 78 (44.34.0) individuals of wild/known descent in 30 Indian zoos and in the historical perspective 328 (146.168.14) specimens of wild/known lineage are recorded in the national studbook. Detailed demographic and genetic analysis was carried out for animals with known ancestry and normal coat colour (all animals having the white gene or of unknown origin were excluded from analysis and placed separately). Results of life table analysis suggested that the captive Bengal tiger population of known origin in Indian zoos is declining. The high values for founder genome surviving and gene diversity retained indicate high genetic variability. However; the mean kinship and the mean inbreeding were quite high. The captive population requires intensive management efforts to ensure the long term survival of a genetically viable and demographically stable population for insurance purpose. It is suggested that an increase of the current population of 78 specimens to 179 specimens over the next 8 years, with a population growth rate of 1.1 would ensure meeting the requirements of a demographically stable population. The captive population has adequate number of living founders accordingly no new founder animals are required for achieving the desired objective of retaining 90% genetic diversity over 50 years. The same can be achieved by judicious pairing choices while breeding the captive population.

RECOMMENDATIONS

Maintaining complete records of all animals that enter zoos :

It is essential that all animals entering a captive collection should have all relevant records maintained for them. The entry can be by way of birth, rescue or exchange. Detailed information on the dates of entry and exit and all the events like mating, births, exchanges/transfers and deaths/releases should be recorded.

If animals are entering the collection by way of rescue, information on location of rescue should be recorded. Similar information should be maintained for releases. This information should be maintained for all species irrespective of their conservation status as species that are currently found in good numbers in free ranging condition today may be threatened with extinction in future. The pedigree records of captive individuals would then assist in managing captive populations of these species.

Training of zoo personnel :

Robust record keeping is essential for the development of accurate studbooks and thereby population management plans. However; except for a few species the data quality for most species continues to remain poor.

A large number of Indian zoos have joined the membership of ISIS (International Species Inventory System). It is mandatory for all members to upload data on species holdings to the ISIS portal using ARKS (Animal Record Keeping Software). This would also provide the records required for compilation of studbooks.

CZA has in the past organized several trainings of Indian zoo personnel towards achieving this end; however only a few zoos continue to upload information on their collection. Additional training if required can be provided so that all zoos provide their information and thereby suitable long term conservation planning can be initiated.

All exchanges should be as per their mating recommendations based on pedigree records :

An important objective of zoos is to maintain demographically stable and genetically viable captive populations of wild animals. This objective can be best achieved by maintaining studbooks for species threatened with extinction in the wild and carrying out breeding based on the pairing recommendations of the respective studbooks. Exchange of animals should also be governed by these pairing recommendations. Once the objective of maintaining captive self sustaining populations is achieved surpluses can be made available to zoos outside the conservation breeding programme for exhibition purposes.

Molecular genetic analysis of relationships should be carried out for those species for which data is of poor quality :

During the course of this project we came across several species for which data was deficient in terms of information on pedigrees and dates of entry and exit of specimens. The latter can not be addressed however; the former can be addressed by carrying out molecular genetic studies to establish the relationships between the captive specimens. This information can be then used to determine pairings and make necessary corrections in the breeding programme to maximize the retention of genetic diversity.

Objectives

The project was initiated in November 2006 with the objective of developing population management plan for the species targeted for conservation breeding by Indian zoos. The studbooks for four species had been earlier compiled by the Institute and ten new species were added to this. The details of species identified for update and initiation of new studbooks are listed below

1. **Update of studbooks of:**
   - One Horned Rhinoceros
   - Asiatic Lion
   - Lion Tailed Macaque
   - Bengal Tiger

2. **Initiation of new studbooks of**
   - Red Panda
   - Snow Leopard
   - Tibetan Wolf
   - Clouded Leopard
   - Hoolock Gibbon
   - Indian Bison - Gaur
   - Dhole - Asiatic Wild Dog
   - Indian Wild Ass
   - Grey Peacock Pheasant
   - Nilgiri Langur

Methods

For compiling studbook of each species the data was collected from the Indian zoos holding that species, by means of mailed questionnaire survey, personal visits and CZA website. Collected data was then entered in SPARKS 1.5 software and studbook report was generated. Subsequently, the SPARKS dataset was exported to PM2000 by creating ~.prn and ~.ped files for demographic and genetic analyses in pm2000. The results of the analysis carried out using demographic analysis features of PM2000 provided an insight into the growth rates of the population; the age classes with maximum likelihood of mortality; and the age classes with maximum probability of individuals to breed or fecundity. The current age distribution of the living individuals of known age in captivity will also derived. The genetic analyses features provided information on the genetic diversity being retained by the current population; the likelihood of offspring of existing animals being inbred and the relationship of each individual animal with every other animal in the population (mean kinship). The pairings scenario of PM2000 provided information on the likely pairings that could be carried out in the population and the inbreeding coefficients and mean kinship of such offsprings.

The results of the demographic and genetic analysis input to the goals scenario provided information on the genetic viability and demographic stability of the target population. In situation when desired levels of genetic diversity was not retained in the future population, the software provided information on the additional numbers of founders and the time intervals at which they need to be added to achieve the target genetic diversity. Additional information on the desired population size to be maintained to retain the target genetic diversity was also derived.

RED PANDA

BIOLOGY AND STATUS

Taxonomy

Kingdom	:	Animalia
Phylum	:	Chordata
Class	:	Mammalia
Order	:	Carnivora
Family	:	Ailuridae
Scientific Name	:	*Ailurus fulgens*
Species Authority	:	F. Cuvier, 1825
Common Name	:	Red Panda
Head & Body length	:	50-60 cm
Tail length	:	30-45 cm
Height	:	20-25 cm
Weight	:	3-6 kg

Distribution

Nepal through north-eastern India (West Bengal, Sikkim, Arunachal Pradesh), Bhutan and China

Habitat

Forests with bamboo understory at an altitudinal range of 1500 - 4800 m. Forest types: temperate montane, subtropical and tropical.

Diet

Mainly bamboo leaves and shoots, occasionally feeds on berries, flowers, seeds, eggs and young birds, small rodents and insects

Sexual Maturity

Approx. 18 months

Gestation Period

Gestation period averages 131 days

Breeding Season

Mating usually takes place in middle to late winter and female give birth usually in June.

Litter Size

1-5, usually 2 young

Longevity

Live up to 14 years in captivity

Threats

Loss and fragmentation of habitat, poaching for skins and for pet trade.

Status

The species shows a declining population trend across its range. Listed in Schedule I of the Wildlife Protection Act (1972) of India and is listed as Vulnerable (C1) in the 2008 IUCN Red List of Threatened Species.

Results & discussion

The present captive population of the species in Indian zoos is given in table 1.1 below, which consists of 22 (17.4.1) individuals housed in 2 zoos. In the historical perspective a total of 66 individuals have been kept in captivity since 1977.

Table 1.1 : Status of captive red panda population in Indian zoos on 31st March 2009

Institution	Male	Female	Unknown	Total
Padmaja Naidu Himalayan Zoological Park, Darjeeling	10	3	1	14
Himalayan Zoological park, Gangtok	7	1	0	8
Totals	**17**	**4**	**1**	**22**

Census and Demography

The details of the census are presented in fig. 1.1. The population has grown from 4 in 1977 to 21 in 2008. Age distribution pattern of the known individuals of captive Red Panda population in Indian zoo is shown in fig. 1.2. From study of the age pyramid it was deduced that the population's sex ratio is highly skewed towards male. The life table suggests that mortality (Qx) (fig.1.3) is highest in the first year of the animal's life for both males and females. Whereas reproductive activity (fig. 1.4) for males starts in the second year of the animal's life, peaks in the 6th year and then gradually tapers off by the 13th year. Similarly for females, reproductive activity also starts in the 2nd year, reaches peak in the 7th year and then drops down and is negligible by the 12th year. Generation length for the population is 5.1 and effective population size is 9.7.

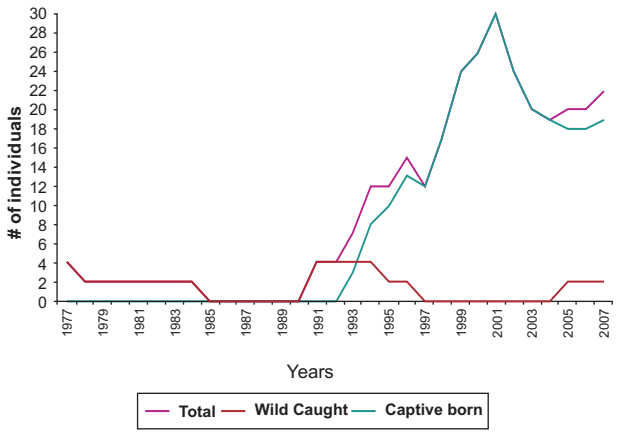

Fig 1.1 : Census Trends of Captive Red Panda

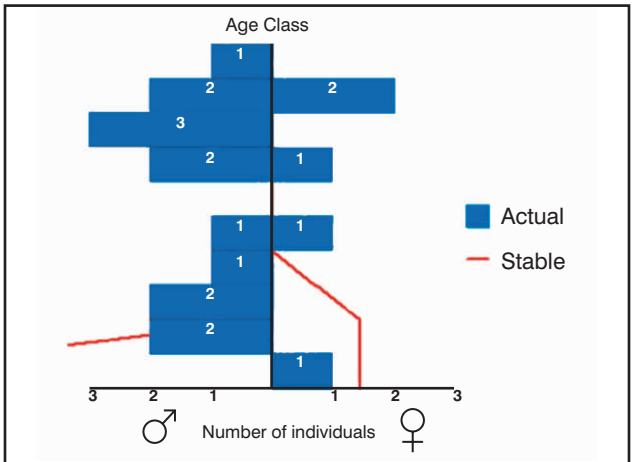

Fig 1.2 : Age Pyramid of Red Panda

Fig 1.3 : Mortality rate of the population

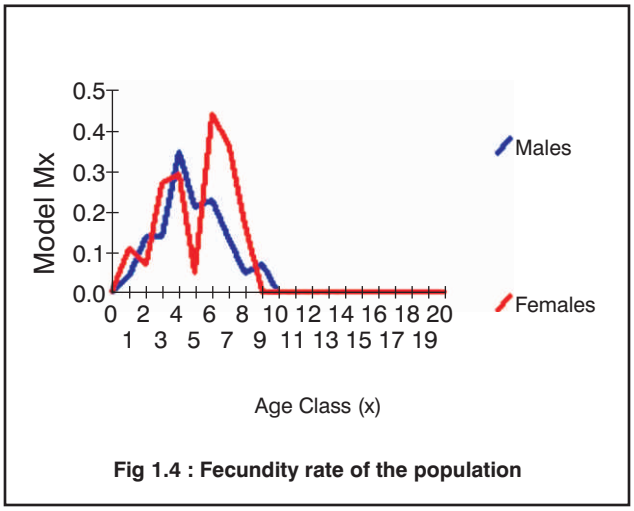

Fig 1.4 : Fecundity rate of the population

Genetic Summary

The population's current gene diversity is moderate at 0.6584 as it has received contributions from 3 founders, besides this there is one more potential founder. The founder statistics is provided in table 1.2. and the founder representation in fig. 1.5 and levels of mean kinship in the population. The mean kinship of the population is 0.3097; while the mean inbreeding coefficient is 0.0294.

Table 1.2 : Founder Statistics

Studbook #	Sex	Age	Representation	Contribution	Allele Retent.	Potential Ret.	Descendants
00009	M	D	0.4744	4.6250	0.8595	0.8595	20.00
00007	F	D	0.4744	4.6250	0.8520	0.8520	20.00
00058	F	4	0.0513	0.5000	0.5000	1.0000	1.00
00059	M	4	0.0000	0.0000	0.0000	1.0000	0.00
00064	M	1	0.0000	0.0000	0.0000	1.0000	0.00
00066	F	0	0.0000	0.0000	0.0000	1.0000	0.00

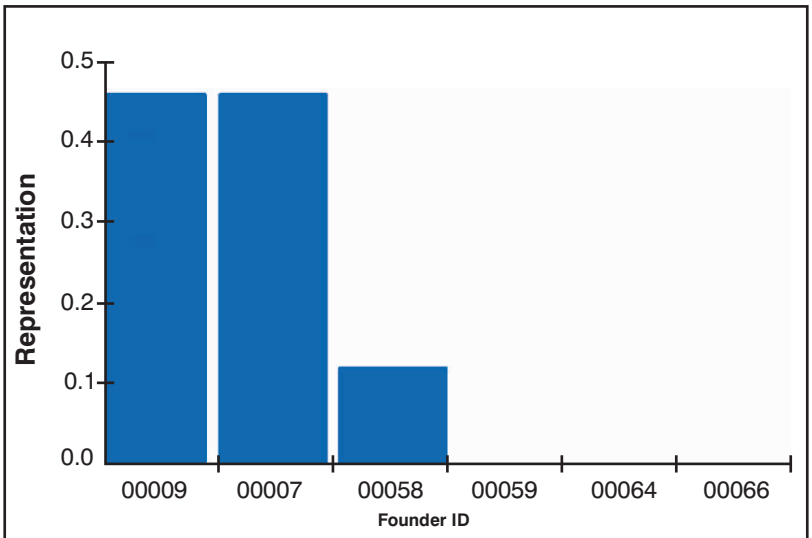

Fig 1.5 : Founder representation in the captive population

Population Planning and Breeding Recommendations

The red panda conservation breeding program is targeted at producing surpluses for restocking. It has so far restocked 4 females; however the current gene diversity is moderate (0.6584) as shown by analysis conducted using PM2000. The target of maintaining at least 90% of the gene diversity at the end of 50 years cannot be achieved with the current population.

Based on modeling done using PM2000 it is recommended that the population requires the addition of one new founder animal annually to the population for the next 50 years. The details of mean kinship matrix of live individuals are provided as Table 1.3.

Table 1.3 : Mean Kinship Matrix of Live Individuals

Males					Females				
Stud ID	**Mean Kinship**	**% known**	**Age**	**Location**	**Stud ID**	**Mean Kinship**	**% known**	**Age**	**Location**
00011	0.500	0.0	16	Darjeeling	00013	0.500	0.0	16	Darjeeling
00018	0.500	0.0	14	Darjeeling	00026	0.365	50.0	12	Singalila
00021	0.365	50.0	13	Darjeeling	00027	0.378	50.0	11	Darjeeling
00037	0.321	50.0	10	Gangtok	00028	0.365	50.0	11	Singalila
00038	0.321	50.0	10	Gangtok	00047	0.365	50.0	8	Singalila
00042	0.340	50.0	9	Darjeeling	00049	0.340	50.0	8	Singalila
00046	0.365	50.0	8	Darjeeling	00057	0.353	50.0	6	Darjeeling
00048	0.378	50.0	8	Darjeeling	00058	0.026	100.0	4	Gangtok
00052	0.333	50.0	7	Gangtok	00063	0.375	50.0	U1	Darjeeling
00053	0.321	50.0	7	Gangtok					
00054	0.378	50.0	6	Darjeeling					
00055	0.378	25.0	6	Gangtok					
00056	0.378	25.0	6	Darjeeling					
00059	0.000	100.0	4	Gangtok					
00060	0.388	50.0	3	Darjeeling					
00061	0.500	0.0	0	Darjeeling					
00062	0.154	75.0	2	Gangtok					
00063	0.375	50.0	U1	Darjeeling					

Details of the number of breeding pairs required to meet population goals and minimize inbreeding coefficient are provided as table 1.4.

Table 1.4 : No. of breeding pairs recommended each year

Year	# Births	# Pairs
0	18	36.0
1	4.5	9.0
2	6.125	12.3
3	7.65625	15.3
4	9.070313	18.1
5	6.837891	13.7
6	7.422363	14.8
7	7.746704	15.5
8	7.769318	15.5
9	7.444069	14.9
10	7.595613	15.2

Breeding recommendations

The pairing recommended for breeding are listed in table 1.5. This has been done to minimize inbreeding.

Table 1.5 : Pairings recommended for breeding

Males	Females	Inbreeding Coefficients of Progeny	Males	Females	Inbreeding Coefficients of Progeny
00042	00058	F = 0.000	00059	00057	F = 0.000
00042	00066	F = 0.000	00059	00058	F = 0.000
00046	00058	F = 0.000	00059	00066	F = 0.000
00046	00066	F = 0.000	00060	00058	F = 0.000
00048	00058	F = 0.000	00060	00066	F = 0.000
00048	00066	F = 0.000	00062	00027	F = 0.083
00052	00058	F = 0.000	00062	00057	F = 0.083
00052	00066	F = 0.000	00062	00066	F = 0.000
00053	00058	F = 0.000	00063	00058	F = 0.000
00053	00066	F = 0.000	00063	00066	F = 0.000
00054	00058	F = 0.000	00064	00027	F = 0.000
00054	00066	F = 0.000	00064	00057	F = 0.000
00055	00058	F = 0.000	00064	00058	F = 0.000
00055	00066	F = 0.000	00064	00066	F = 0.000
00056	00058	F = 0.000	00065	00027	F = 0.083
00056	00066	F = 0.000	00065	00057	F = 0.083
00059	00027	F = 0.000	00065	00066	F = 0.000

SNOW LEOPARD

BIOLOGY AND STATUS

Taxonomy	Kingdom	:	Animalia
	Phylum	:	Chordata
	Class	:	Mammalia
	Order	:	Carnivora
	Family	:	Felidae
	Scientific Name	:	*Uncia uncia*
	Species Authority	:	(Schreber, 1775)
	Common Name/s	:	Ounce, Snow Leopard, Shaan (Ladakhi)
Morphometry	Weight	:	27 - 54 kg
	Body length	:	74 - 130 cm
Distribution	Parts of India, Pakistan, Nepal, Bhutan, Tibet, Afghanistan, China, Kazakhstan, Uzbekistan, Tajikistan, Mongolia and the Russian Federation. In India the species occupies trans-Himalayan region in the states of Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim and Arunachal Pradesh.		
Habitat	An inhabitant of alpine forests and sub-alpine scrub, does equally well even in flat terrain with adequate cover.		
Diet	Large ungulates, also feeds on birds and small mammals		
Mating season	Winter		
Gestation Period	93 - 108 days		
Litter Size	2 - 3 cubs		
Longevity	In wild live up to 18 years and in captivity the maximum longevity achieved is 20 years.		
Threats	Loss of habitat and reduction of prey base, poaching for skin and bones and conflict with human resulting in retaliatory killing.		
Status	Listed in Schedule I of the Wildlife Protection Act (1972) of India and is listed as endangered in the 2008 IUCN Red List of Threatened Species.		

Results & Discussion

In the historical perspective a total of 51 individuals have been kept in captivity since 1978. The present status of the captive snow leopard population in India is given below:

Table 2.1 : Status of Snow Leopard in Indian Zoos (as on 31st June 2009)

Zoo Name	Male	Female	Unsexed	Total
Pt. Govind Ballabh Pant High Altitude Zoo, Nainital	9	5	3	17
Himalayan Nature Park, Kufri	1	0	0	1
Himalayan Zoological Park, Gangtok	1	0	0	1
Padmaja Naidu Himalayan Zoological Park, Darjeeling	1	1	0	2
Total	**12**	**6**	**3**	**21**

Census and Demography

The year wise trends in population can be referred to in fig. 2.1. The present snow leopard captive population in India was founded by the acquisition on breeding loan of a male in 1978 and a female in 1980 from Helsinki and San Antonio zoos respectively.

Fig. 2.2 represents the age structure of the living population of captive snow leopard in India. The figure suggests that the population is susceptible to random stochastic events and the population has a biased sex ratio in favour of males. The population has 8 males and 5 females in the reproductive age group.

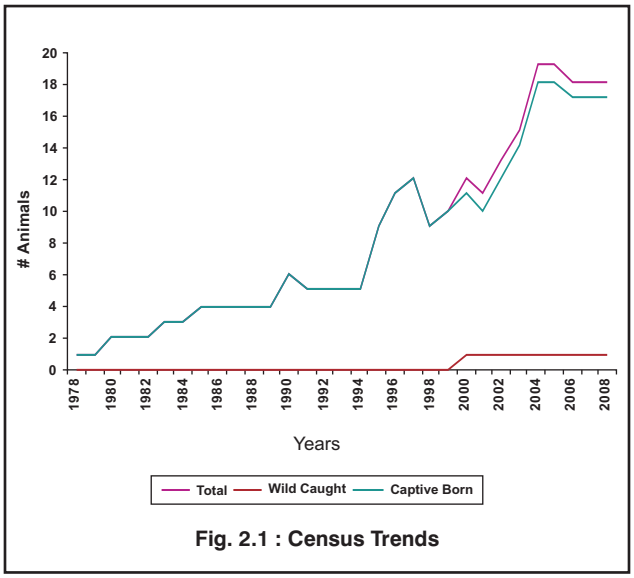

Fig. 2.1 : Census Trends

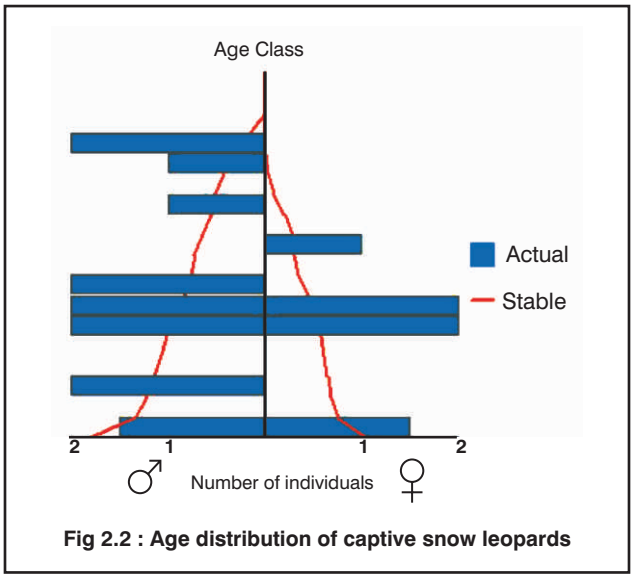

Fig 2.2 : Age distribution of captive snow leopards

The life tables suggest that the male and the female population are growing at the rate of 1.0626 and 1.0535 respectively. Generation length (T) was found to be 9.08 and 6.82 years for males and females respectively while the Net Reproductive rate (Ro), was 1.736 and 1.427 respectively for males and females. The mortality and fecundity rate of the population are presented in graphical form in fig. 2.3 and 2.4. The male life table suggests that mortality shows a peak at the age class 0 - 1 year and then again peaks at 11th and 14th years of age and achieves a plateau from the 16th year. Reproductive activity in males is initiated in the 4th year of life and peaks in the 9th year and 14th years respectively. Female life table also shows an initial peak in mortality in the first year and then peaks at 8 years, and then shows an increasing trend from 11th to 14th years and thereafter achieves a plateau. Reproductive activity in females is initiated in the 4th year and peaks in the 7th and 10th years respectively and then suddenly drops. The sample size is however too small to make meaningful predictions based on the life table analyses.

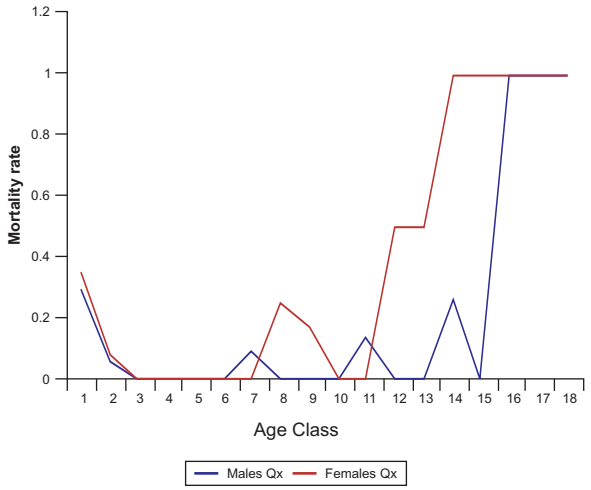

Fig. 2.3 : Comparision of Male/Female mortality rates

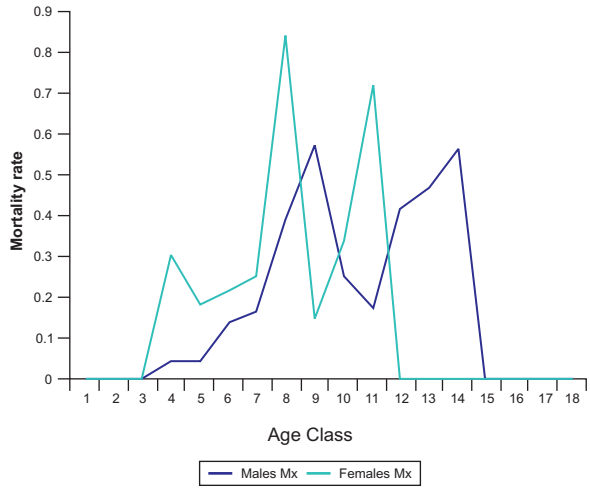

Fig. 2.4 : Comparision of Male/Female fecundity rates

Genetic Summary

The captive snow leopard population has only one founder of wild origin which has contributed to the population and has seven descendants. Thus, the genetic diversity retained by the present population is 0.4286 while the genetic variability of the population (GV) is 0.4270 and the founder genome equivalent (fge) is 0.88. Though, the mean kinship coefficient for the snow leopard captive population is very high at 0.5535 yet its inbreeding coefficient is zero.

Population Planning/ Recommendations

It is suggested that new founders be added to the captive population and the population size be increased to at least 100 individuals with equal sex ratio in the period of the next 10 years.

The population projections for both actual and modeled populations suggest that the goal of maintaining at least 100 genetically viable and demographically stable individuals in captivity in India cannot be achieved without the addition of fresh founders and utilizing the reproductive potential of the captive population to the maximum.

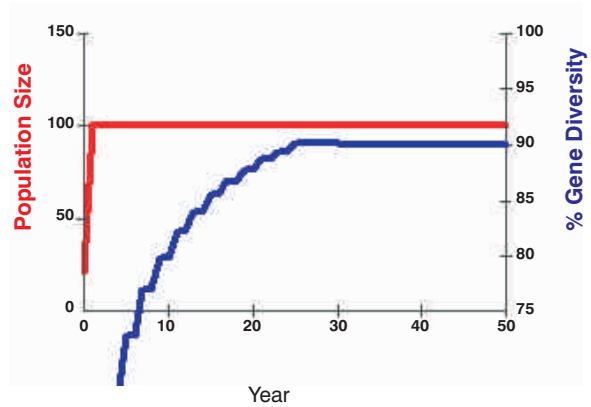

Fig. 2.5 : Demographic and genetic management strategy

Other variables:

Current Population Size	=	21.0000
Current Effective Size	=	42.0000
Ratio of Ne/N	=	2.0000
Current Gene Diversity	=	0.4286
Maximum Allowable Population Size	=	100.0000
Population Size Needed to Meet Goals	=	100.0000
Year to Start Adding Founders	=	1.0000
Year to Stop Adding Founders	=	25.0000
Years Between Addition Events	=	2.0000
FGE Recruited per New Founder	=	0.4000

Goal settings

New Founders per Addition Event Needed = 2

Program Objectives

90% Gene Diversity at the end of 50 years

Hypothetical pairings of the living population were carried out using PM2000 to determine possible mating choices for the living population. The details of individuals available for pairing are included in table 2.4 where F represents the inbreeding coefficient, MK the mean kinship and % known is the percentage of known ancestry of the individual. The results of the hypothetical pairings suggest that mating can be carried out between the various individuals and this would raise the genetic variability of the population from the present value of 0.4286 to 0.4465 if all the mating options (table - 2.2) are exercised.

Table 2.2 : Mean kinship of living individuals

Males					Females				
Stbk#	**MK**	**%Known**	**Age**	**Location**	**Stbk#**	**MK**	**%Known**	**Age**	**Location**
00014	0.500	0.0	14	Darjeelingg	00026	0.500	0.0	9	Nainital
00016	0.500	0.0	14	Darjeeling	00028	0.500	100.0	0	Darjeeling
00017	0.500	0.0	13	Darjeeling	00037	0.595	50.0	6	Darjeeling
00022	0.500	0.0	11	Darjeeling	00040	0.595	50.0	6	Darjeeling
00034	0.500	0.0	7	Darjeeling	00044	0.500	0.0	5	Darjeeling
00035	0.500	0.0	7	Kufri	00045	0.500	0.0	5	Darjeeling
00038	0.500	0.0	6	Darjeeling	00049	0.514	50.0	U0	Darjeeling
00039	0.500	0.0	6	Nainital	00050	0.514	50.0	U0	Darjeeling
00042	0.500	0.0	5	Darjeeling	00051	0.514	50.0	U0	Darjeeling
00043	0.500	0.0	5	Gangtok					
00046	0.554	50.0	2	Darjeeling					
00048	0.554	50.0	2	Darjeeling					
00049	0.514	50.0	U0	Darjeeling					
00050	0.514	50.0	U0	Darjeeling					
00051	0.514	50.0	U0	Darjeeling					

Table 2.3 below provides detailed information on the animal pairing recommended for breeding. The mating options can be used keeping in view the fact that animal movements are kept at a minimum as the inbreeding coefficients between all the pairings suggested is 0.

Table 2.3 : Pairings recommended for breeding

Sl.No.	Sire	Dam	Inbreeding coefficient	Sl.No.	Sire	Dam	Inbreeding coefficient
1.	00014	00026	F = 0.000	14.	00017	00028	F = 0.000
2.	00014	00028	F = 0.000	15.	00017	00037	F = 0.000
3.	00014	00037	F = 0.000	16.	00017	00040	F = 0.000
4.	00014	00040	F = 0.000	17.	00017	00044	F = 0.000
5.	00014	00044	F = 0.000	18.	00017	00045	F = 0.000
6.	00014	00045	F = 0.000	19.	00022	00026	F = 0.000
7.	00016	00026	F = 0.000	20.	00022	00028	F = 0.000
8.	00016	00028	F = 0.000	21.	00022	00037	F = 0.000
9.	00016	00037	F = 0.000	22.	00022	00040	F = 0.000
10.	00016	00040	F = 0.000	23.	00022	00044	F = 0.000
11.	00016	00044	F = 0.000	24.	00022	00045	F = 0.000
12.	00016	00045	F = 0.000	25.	00034	00026	F = 0.000
13.	00017	0002	F = 0.000	26.	00034	00028	F = 0.000

Sl.No.	Sire	Dam	Inbreeding coefficient	Sl.No.	Sire	Dam	Inbreeding coefficient
27.	00034	00037	F = 0.000	47.	00039	00044	F = 0.000
28.	00034	00040	F = 0.000	48.	00039	00045	F = 0.000
29.	00034	00044	F = 0.000	49.	00042	00026	F = 0.000
30.	00034	00045	F = 0.000	50.	00042	00028	F = 0.000
31.	00035	00026	F = 0.000	51.	00042	00037	F = 0.000
32.	00035	00028	F = 0.000	52.	00042	00040	F = 0.000
33.	00035	00037	F = 0.000	53.	00042	00044	F = 0.000
34.	00035	00040	F = 0.000	54.	00042	00045	F = 0.000
35.	00035	00044	F = 0.000	55.	00043	00026	F = 0.000
36.	00035	00045	F = 0.000	56.	00043	00028	F = 0.000
37.	00038	00026	F = 0.000	57.	00043	00037	F = 0.000
38.	00038	00028	F = 0.000	58.	00043	00040	F = 0.000
39.	00038	00037	F = 0.000	59.	00043	00044	F = 0.000
40.	00038	00040	F = 0.000	60.	00043	00045	F = 0.000
41.	00038	00044	F = 0.000	61.	00046	00026	F = 0.000
42.	00038	00045	F = 0.000	62.	00046	00044	F = 0.000
43.	00039	00026	F = 0.000	63.	00046	00045	F = 0.000
44.	00039	00028	F = 0.000	64.	00048	00026	F = 0.000
45.	00039	00037	F = 0.000	65.	00048	00044	F = 0.000
46.	00039	00040	F = 0.000	66.	00048	00045	F = 0.000

TIBETAN WOLF

BIOLOGY AND STATUS

Taxonomy

Kingdom	:	Animalia
Phylum	:	Chordata
Class	:	Mammalia
Order	:	Carnivora
Family	:	Canidae
Scientific Name	:	*Canis lupus chanco*
Species Authority	:	Gray, 1863
Common Name	:	Tibetan wolf

Morphometry

Body length	:	100-130 cm
Weight	:	15-20 kg

Habitat & Distribution

The animal inhabits the trans-Himalayan region and the Tibetan Plateau.

Diet

Opportunistic feeders, predating medium to large sized ungulates; eat any meat that is available, including non-ungulate species, carrion and garbage.

Sexual maturity

2-3 years

Mating season

Between January and April

Gestation Period

60-63 days

Litter Size

5-6 pups

Longevity

6-10 years (in wild); 12-20 (in captivity)

Group size & structure

Pack size of 2 - 20 wolves, 8 is the usual size; pack comprises the breeding pair, new litter and young from previous season until they mature.

Threats

Reducing habitat and increasing conflict with human

Status

Is placed in the Schedule I of the Wildlife Protection Act, Govt of India (1972) and in Appendix I of CITES. However it is yet to be listed in IUCN Red List of Threatened species.

Results & discussion

Tibetan wolf captive population is presently being maintained in four facilities in the country (Table 3.1). A total of 49 individuals have been held in Indian zoos since 1990.

Table 3.1 : Status of captive Tibetan Wolf population in Indian zoos as on 31st March 2009

Institution	Male	Female	Unsexed	Total
Padmaja Naidu Himalayan Zoological Park, Darjeeling	2	5	0	7
Himalayan Zoological Park, Gangtok	2	2	0	4
Himalayan Nature Park, Kufri	2	1	0	3
Pt. Gobind Vallabh Pant High Altitude Zoo, Nainital	2	1	0	3
Total	**8**	**11**	**0**	**17**

Census and Demography

The present day captive population of Tibetan Wolf in Indian zoos owes its origin to individuals obtained from wild. The year wise trends in census can be inferred from fig. 3.1.

Age distribution pattern (fig. 3.2) of the known age individuals of captive Tibetan Wolf population shows maximum number of individuals to belong to the reproductive age class (5 - 8 years of age).

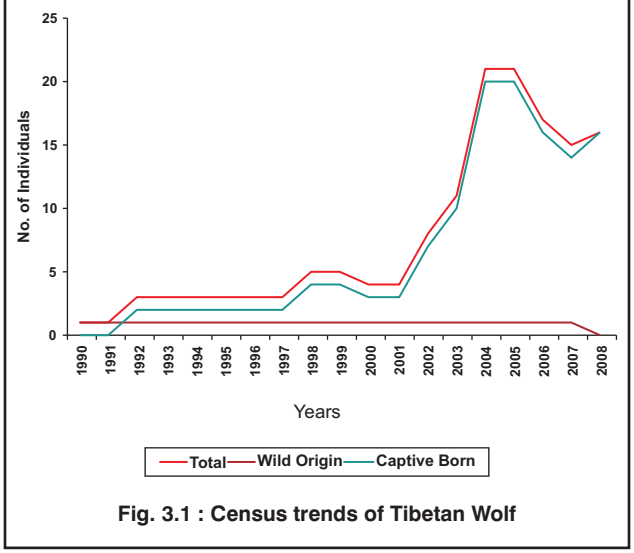

Fig. 3.1 : Census trends of Tibetan Wolf

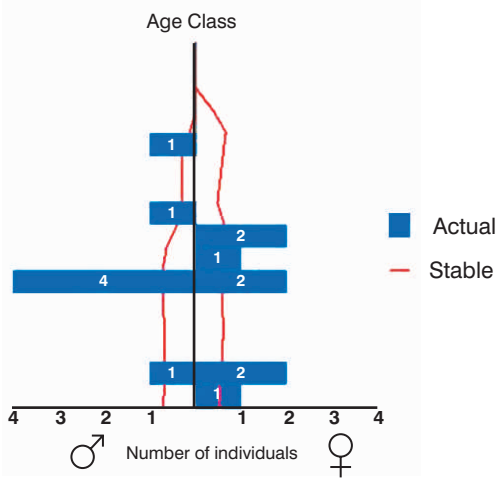

Fig. 3.2 : Age structure of known age individuals

Using life table data the mortality and fecundity rates have been graphically represented in figs. 3.3 and 3.4 respectively. The life table suggests that males become sexually active by the fifth year of life [fecundity (Mx)], peaks in the 7th year and then the reproductive activity abruptly ceases. Similar trends were also observed for females. Mortality (Qx) shows initial low levels in the first two years for males and then reaches an abrupt peak in the 9th year, while females show an initial peak in the first year and then another peak in the 9th year. The Population Growth Rate (lambda), a measure of the population for self sustainment was 0.98 and 0.88 respectively, which suggests that the population is declining. It is pertinent to mention here that all the above mentioned values are based on small sample sizes (~N<30) and therefore warrant less confidence.

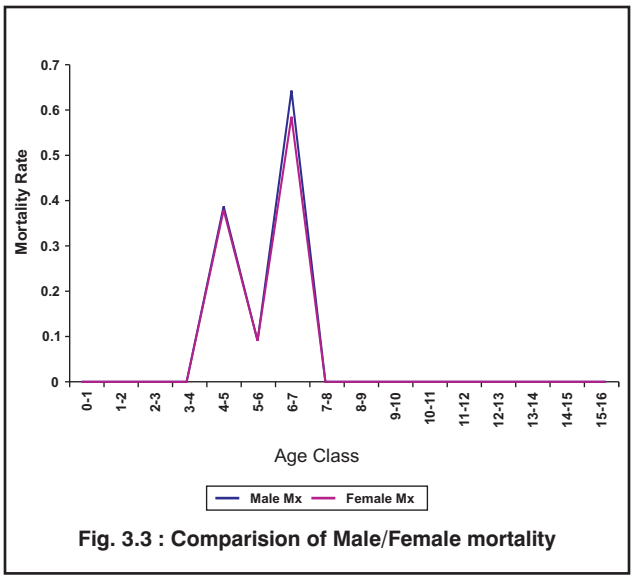

Fig. 3.3 : Comparision of Male/Female mortality

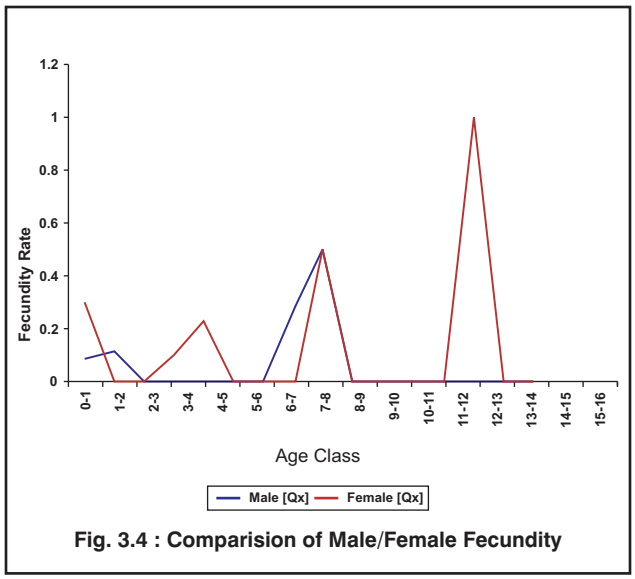

Fig. 3.4 : Comparision of Male/Female Fecundity

Genetic Summary

It is not possible to carry out genetic analysis of the Indian captive Tibetan Wolf population as the ancestry of only two individuals could be traced back to founder (wild caught) individuals. The pedigree of offspring thus produced could not be traced in subsequent generations; therefore the founder statistics or any other genetic analyses are of little relevance.

Population Planning and Breeding Recommendations

A total of 3 animals of wild origin have entered the captive population while a total of 30 animals of unknown parentage are present in a total population of 49 animals. However, only two births (Studbook Nos. 00004 and 00005) can be traced back to known founder animals (Studbook Nos. 00002 and 00003). It is therefore not possible to make any recommendations for Tibetan wolf based on the analysis carried out using PM 2000.

It is suggested that molecular genetic studies may be carried out to ascertain relatedness of individuals. This information can than be used to make breeding recommendations.

CLOUDED LEOPARD

BIOLOGY AND STATUS

Taxonomy	Kingdom	:	Animalia
	Class	:	Mammalia
	Order	:	Carnivora
	Family	:	Felidae
	Scientific Name	:	*Neofelis nebulosa*
	Species Authority	:	Griffith, 1821
	Common Name	:	Clouded leopard (Eng.) Lamchita, Gecho bagh (Bangla)
Morphometry	Body length	:	80-90 cm
	Tail length	:	80-90 cm
	Weight	:	11-20 kg
Distribution	The species range extends from the Himalayan foothills in Nepal through mainland south-east Asia to China. In India it occurs in the states of Sikkim, West-Bengal, Assam, Arunachal Pradesh and Tripura.		
Habitat	Inhabits mixed evergreen forests.		
Diet	Birds, primates and small mammals, as well as larger prey, such as porcupines, deer, and wild boar.		
Sexual maturity	20 to 30 months		
Litter Size	1 - 5 cubs (average 2)		
Longevity	In free ranging condition may thrive for about 11 years and 14 - 17 years in captivity		
Threats	Habitat destruction and associated loss of cover and prey base, extensively hunted for the illicit wildlife trade in skins, bones for medicines.		
Status	The wild population is declining. Ranked as Vulnerable [criterion C1 + 2a(I)] of IUCN Red list of Threatened species, version 2009. 1 and Schedule I of the Wild Life Protection Act; Govt. of India. It is also protected by legislation in most of its range countries. It is included in CITES Appendix I due to the extensive illicit trade.		

Results & discussion

The clouded leopard population in Indian zoos owes its origin to wild caught founder animals. The present population has 25 animals (table 4.1) of which 11 animals are of wild origin. Historically a total of 36 (18.16.2) individuals have so far been kept in captivity.

Table 4.1 : Population status of clouded leopards in Indian zoos

Zoo Name	Population Status			
	Males	Females	Unsexed	Total
Aizawl Zoo (Mizoram Zoo)	0	1	0	1
Nagaland Zoological Park, Rangapahar *	1	1	0	2
Sepahijala Zoological Park	9	9	0	18
Padmaja Naidu Himalayan Zoological Park	1	1	0	2
Assam State Zoo	2	0	0	2
Total	**13**	**12**	**0**	**25**

*Population data for Nagaland Zoological Park, Rangapahar is based on Central Zoo Authority Inventory the same is excluded from demographic and genetic analysis due to non availability of data

Census and Demography

Sepahajala Zoological Park is the only Indian zoo so far to have bred the species in captivity. Figure 4.1 presents the census trends in captivity from 1992 - 2008.

Fig. 4.2 represents the age structure of the known age individuals of the living Indian captive population of clouded leopards. The results obtained for stable age distribution (modeled data) suggest that a higher birth rate is required to maintain a stable population, whereas the actual population has lower recruitment in the first two years of life for both males and females and during the 5th and 6th years for females.

The life table generated for clouded leopard in captivity is based on an extremely small sample size of 19 individuals therefore meaningful conclusions can not be drawn from it, and its utility for predictions is poor.

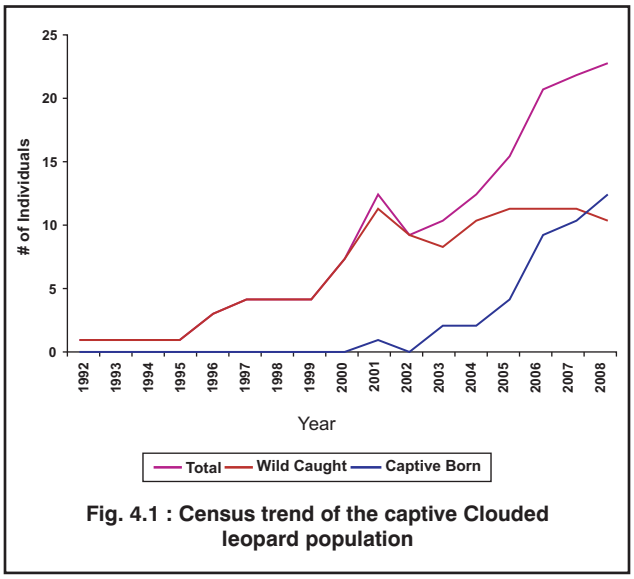

Fig. 4.1 : Census trend of the captive Clouded leopard population

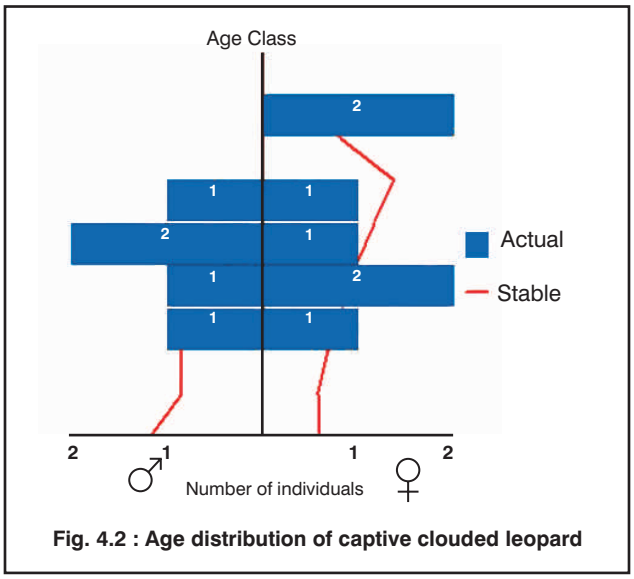

Fig. 4.2 : Age distribution of captive clouded leopard

Genetic Summary

Table 4.2 summaries the genetics of the Indian captive clouded leopard population.

Table 4.2 : Genetic summary of the captive clouded leopard population

	Current	Potential
Founders	6	6
fge	3.24	6.17
Founder Genomes Surviving	4.75	11.93
GD	0.8455	0.9581
GV	0.8022	0.9233
MK	0.0811	
Mean F	0.0000	
Percent Known	100.0%	
Captive births : 19		**Wild origin : 17**

Fig. 4.3 summarizes the founder contribution in the living population of clouded leopards in captivity in India. Studbook number 00004 (male) and 00005 (female) are overrepresented while most of the founders or potential founders are underrepresented or not represented at all respectively.

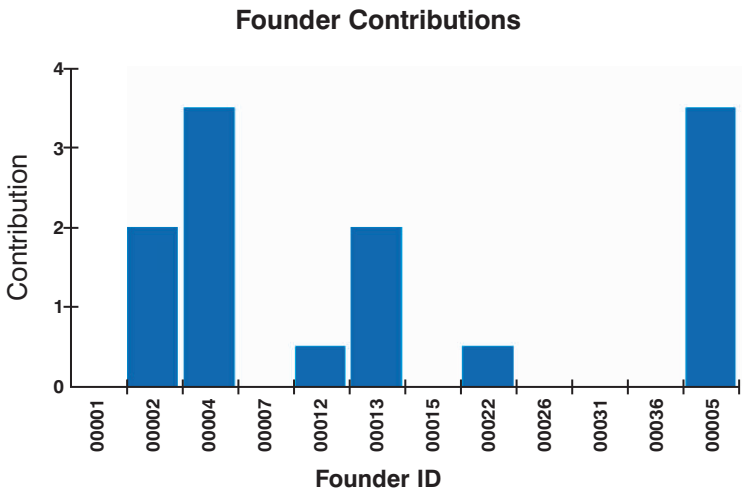

Fig. 4.3 : Founder contributions in the captive clouded leopard population

The population has a low mean kinship value of 0.0811 and inbreeding coefficient of 0. A perusal of the table suggests that there is no problem of inbreeding in the current captive clouded leopard population in India. The captive population has a good representation of founder genomes. Accordingly, while making breeding choices locations should be given greater importance than other criteria as movements over long distances can be avoided by pairing animals at the same location or moving animals to a minimal distance.

Population Planning and Breeding Recommendations

The species has a global programme for its ex- situ conservation as well. The Indian captive population is a part of the much larger global captive population. In view of the above it is envisaged that a target of achieving a population size of 100 individuals with an equal sex ratio spread over 4 or more zoos during the next 10 years would serve the purpose of maintaining the species in captivity for insurance. It has to be ensured that these 100 individuals form a demographically stable and genetically viable population. The present captive population is suitable for initiating a genetically viable and demographically stable population.

It was not possible to run the goals scenario in PM2000 that models genetic diversity and population sizes over a predefined period of time because of small number of known age individuals in the captive population. Hypothetical pairing based on an ordered list of mean kinships (table 4.3) was carried out for living individuals using PM2000. The report generated provides the inbreeding coefficients of the hypothetical offspring. Accordingly table 4.4 lists pairs which may be used to produce genetic diversity. The movement of animals from one zoo to another should be minimized while implementing the pairings.

Table 4.3 : Ordered list of mean kinships by sex

Males					Females				
Studbook No.	Mean Kinship	% Known	Age	Location	Studbook No.	Mean Kinship	% Known	Age	Location
00001	0.000	100.0	17	Assam	00012	0.035	100.0	0	Sepahijala
00002	0.055	100.0	0	Sepahijala	00018	0.119	100.0	7	Sepahijala
00004	0.093	100.0	0	Sepahijala	00020	0.132	100.0	7	Sepahijala
00007	0.025	100.0	0	Sepahijala	00022	0.032	100.0	0	Sepahijala
00013	0.079	100.0	0	Sepahijala	00024	0.098	100.0	5	Sepahijala
00016	0.025	100.0	8	Assam	00026	0.020	100.0	0	Darjeeling
00025	0.100	100.0	5	Sepahijala	00027	0.106	100.0	4	Sepahijala
00028	0.108	100.0	4	Sepahijala	00032	0.100	100.0	3	Sepahijala
00029	0.078	100.0	4	Sepahijala	00033	0.075	100.0	3	Sepahijala
00030	0.101	100.0	3	Sepahijala	00035	0.118	100.0	2	Sepahijala
00031	0.025	100.0	0	Darjeeling	00036	0.020	100.0	0	Aizawl
00034	0.121	100.0	2	Sepahijala					

Table 4.4 : Pairs recommended for breeding

Sl.No.	Sire	Dam	*Inbreeding coefficient*	Sl.No.	Sire	Dam	*Inbreeding coefficient*
1.	00007	00012	0.000	19.	00013	00033	0.000
2.	00007	00018	0.000	20.	00013	00036	0.000
3.	00007	00020	0.000	21.	00016	00012	0.000
4.	00007	00022	0.000	22.	00016	00018	0.000
5.	00007	00024	0.000	23.	00016	00020	0.000
6.	00007	00026	0.000	24.	00016	00022	0.000
7.	00007	00027	0.000	25.	00016	00024	0.000
8.	00007	00032	0.000	26.	00016	00026	0.000
9.	00007	00033	0.000	27.	00016	00027	0.000
10.	00007	00035	0.000	28.	00016	00032	0.000
11.	00007	00036	0.000	29.	00016	00033	0.000
12.	00013	00012	0.000	30	00016	00035	0.000
13.	00013	00018	0.000	31.	00016	00036	0.000
14.	00013	00020	0.000	32.	00025	00012	0.000
15.	00013	00022	0.000	33.	00025	00022	0.000
16.	00013	00026	0.000	34.	00025	00026	0.000
17.	00013	00027	0.000	35.	00025	00033	0.000
18.	00013	00032	0.000	36.	00025	00036	0.000

Sl.No.	Sire	Dam	*Inbreeding coefficient*	Sl.No.	Sire	Dam	*Inbreeding coefficient*
37.	00028	00012	0.000	51.	00031	00020	0.000
38.	00028	00022	0.000	52.	00031	00022	0.000
39.	00028	00026	0.000	53.	00031	00024	0.000
40.	00028	00036	0.000	54.	00031	00026	0.000
41.	00029	00022	0.000	55.	00031	00027	0.000
42.	00029	00024	0.000	56.	00031	00032	0.000
43.	00029	00026	0.000	57.	00031	00033	0.000
44.	00029	00036	0.000	58.	00031	00035	0.000
45.	00030	00012	0.000	59.	00031	00036	0.000
46.	00030	00022	0.000	60.	00034	00012	0.000
47.	00030	00026	0.000	61.	00034	00022	0.000
48.	00030	00036	0.000	62.	00034	00026	0.000
49.	00031	00012	0.000	63.	00034	00036	0.000
50.	00031	00018	0.000				

A serious cause of concern in the captive clouded leopard population in Indian zoos is the low fecundity levels and poor survival rate of offspring produced. Possible causes for this low fecundity might be improper housing and/or husbandry of clouded leopards. Enclosure designs must take into consideration the secretiveness of the species and its adaptations to arboreal life. If natural methods of reproduction fail then assisted reproductive techniques must be thought of as an option. Presently only Sepahijala Zoological Park has a breeding population, the other zoos housing clouded leopards may look at the option of acquiring some animals either from Sepahijala or other institutions and initiate steps necessary to development of self sustainable captive populations with possible surpluses for future reintroductions.

HOOLOCK GIBBON

BIOLOGY AND STATUS

Taxonomy	Kingdom	:	Animalia
	Phylum	:	Chordata
	Class	:	Mammalia
	Order	:	Primates
	Family	:	Hylobatidae
	Scientific Name	:	*Hoolock hoolock*
	Species Authority	:	Harlan, 1834
	Local Name	:	Ulluck (Hindi)
Morphometry	Height	:	45- 64 cm
	Weight	:	6 - 9 kg
Distribution	Its current distribution range is restricted between south of river Brahmaputra and river Irrawaddy in Myanmar. In India it is found in the states of Assam, Arunachal Pradesh, Meghalaya, Manipur, Mizoram, Nagaland and Tripura		
Habitat	Inhabits tropical mixed deciduous and evergreen forests up to an altitude of 1400m.		
Diet	Diet consists of fruits, leaves, flowers, insects and bird eggs		
Sexual maturity	≅ 7 years		
Mating period	Early monsoon		
Gestation Period	195- 210 days		
Birth Season	Winter		
Troop structure & size	Small monogamous groups comprising of a mated pair and offspring. Troop size varies from 2-6 individuals.		
Threats	Habitat destruction and fragmentation due to shifting cultivation and commercial cultivation, poaching for bush meat and use in traditional medicine		
Status	Listed in Schedule I Part I of the Wild Life (Protection) Act, 1972 and classified as Endangered (Endangered A2acd+3cd+4acd ver 3.1 (1994)) in the 2009 IUCN Red List of Threatened Species, and listed on Appendix I of CITES.		

Results & discussion

The species is currently distributed across 9 zoos in India and the current population is 40 the details of which have been presented in table 5.1. Since 1990 a total of 43 (20.16.7) individuals have been housed in Indian zoos.

Table 5.1 : Population status of Hoolock gibbon in Indian zoos

Name of the Zoo	Male	Female	Unknown	Total
Assam State Zoo cum Botanical Garden, Guwahati	1	1	0	2
Lucknow Zoological Park, Lucknow*	1	1	0	2
National Zoological Park, Delhi	0	1	0	1
Sepahijala Zoological Park, Tripura	1	3	0	4
Manipur Zoological Garden, Imphal*	1	1	0	2
Aizawl Zoo, Aizawl	4	4	1	9
Biological Park, Itanagar	10	5	2	17
Mini Zoo, Roing	0	0	1	1
Mini Zoo, Miao	0	1	0	1
Total	**18**	**17**	**4**	**40**

** Data based on Central Zoo Authority inventory for the year 2008 - 2009 (cza.nic.in).*

Census and Demography

Census report for captive Hoolock gibbon in Indian zoos is presented in fig. 5.1 and shows a low level of captive births throughout the history of the species in captivity. The larger part of the captive population comprises of individuals of wild origin.

Fig. 5.2 presents the age structure of the population. It suggests the number of individuals of both sexes in each age class required to maintain a demographically stable population at the current population size of known age individuals.

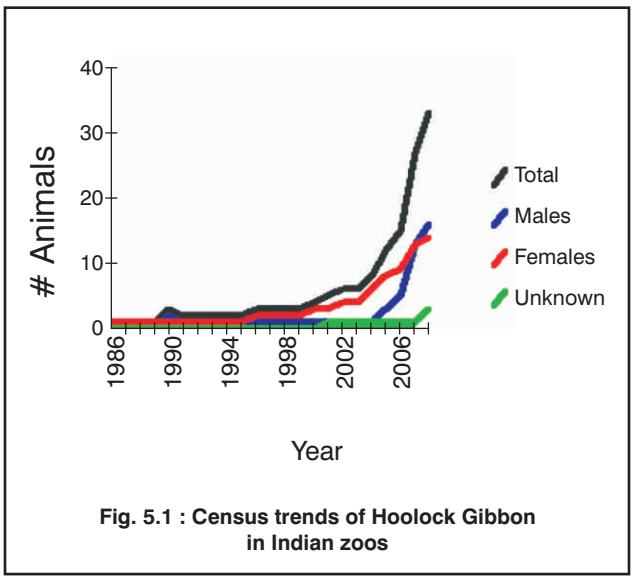

Fig. 5.1 : Census trends of Hoolock Gibbon in Indian zoos

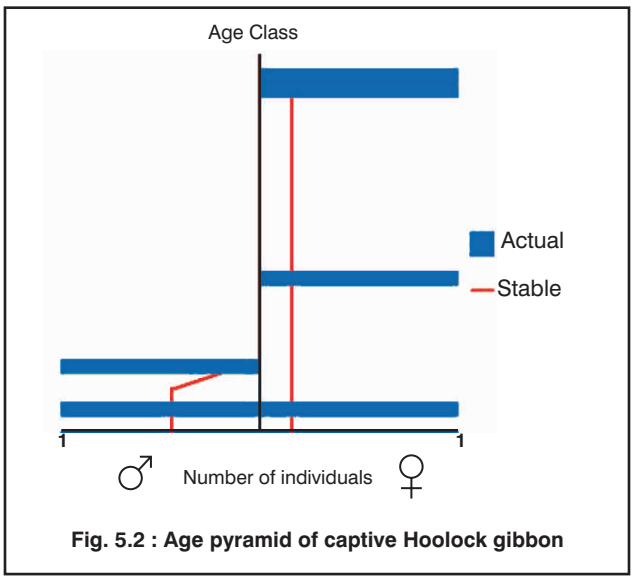

Fig. 5.2 : Age pyramid of captive Hoolock gibbon

Table 5.2 : Projected population growth rates

Males	Females
T = 0	T = 0
Ro = 0.000	Ro = 0.000
λ = 0.000	λ =0.000
r = 0.000	r = -0.000

Life tables were generated for both male and female populations, the results of which are presented in Population growth rate table (table 5.2). Fecundity levels for both males and females are poor. None of the births occurring in the captive population could be attributed to known age individuals. The absence of known age individuals also makes it difficult to arrive on any value for the various demographic parameters. The low levels of fecundity may be an outcome of drawbacks in enclosure design or improper feeding regime as hoolock gibbons are primarily an arboreal species spending most of the active time in the canopy layer foraging.

Genetic Summary

Table 5.3 summarizes the genetic values of the captive population of Hoolock gibbon in Indian zoos. The captive Hoolock gibbon population comprises largely of wild origin individuals and if all individuals contribute to the population the genetic variability would be much more enhanced then compared to the existing population.

Table 5.3 : Genetic summary of the captive Hoolock gibbon population

Variables	Current	Potential
Founders	3	29
fge	1.64	32.00
Founder Genomes Surviving	2.00	32.00
GD	0.6944	0.9844
GV	0.0000	
MK	0.3056	
Mean F	0.0000	
Percent Known	75.0	

Analysis of founder statistics reveals that as yet only 2 females (00024 and 00027) and one male (00026) have contributed their genes to the captive population. The remaining individuals have yet to make any genetic contribution to the population.

All the individuals in the population have a mean kinship of 0.3056 and inbreeding coefficient for all is zero. The present population has no inbreeding depression in it as a large part of the population is of wild origin.

Population Planning and Breeding Recommendations

Though the population is characterized by its high potential to be a viable population, very little breeding has actually occurred.

Table 5.4 : Ordered list of mean kinships by sex

Males					Females				
Studbook No.	Mean Kinship	% Known	Age	Location	Studbook No.	Mean Kinship	% Known	Age	Location
00003	0.000	100.0	0	Assam	00002	0.500	0.0	23	Delhi
00009	0.000	100.0	U0	Roing	00004	0.000	100.0	24	Sepahijala
00013	0.000	100.0	0	Aizawl	00005	0.000	100.0	0	Aizawl
00016	0.000	100.0	0	Aizawl	00009	0.000	100.0	U0	Roing
00020	0.000	100.0	0	Aizawl	00010	0.000	100.0	10	Sepahijala
00021	0.000	100.0	0	Aizawl	00011	0.000	100.0	0	Aizawl
00022	0.000	100.0	0	Itanagar	00012	0.000	100.0	0	Aizawl
00025	0.000	100.0	0	Itanagar	00014	0.000	100.0	0	Sepahijala
00026	0.208	100.0	0	Itanagar	00015	0.000	100.0	0	Assam
00028	0.333	100.0	0	Itanagar	00018	0.000	100.0	0	Aizawl

Males					Females				
Studbook No.	Mean Kinship	% Known	Age	Location	Studbook No.	Mean Kinship	% Known	Age	Location
00029	0.000	100.0	4	Itanagar	00023	0.000	100.0	0	Itanagar
00031	0.000	100.0	0	Itanagar	00024	0.083	100.0	0	Itanagar
00032	0.000	100.0	0	Itanagar	00027	0.208	100.0	0	Itanagar
00033	0.000	100.0	0	Itanagar	00030	0.000	100.0	0	Itanagar
00034	0.000	100.0	0	Itanagar	00038	0.000	100.0	0	Itanagar
00036	0.000	100.0	0	Sepahijala	00039	0.292	100.0	U1	Itanagar
00037	0.000	100.0	0	Itanagar	00040	0.292	100.0	U1	Itanagar
00039	0.292	100.0	U1	Itanagar	00041	0.000	100.0	U0	Aizawl
00040	0.292	100.0	U1	Itanagar	00042	0.000	100.0	U0	Shillong
00041	0.000	100.0	U0	Aizawl	00043	0.000	100.0	0	Miao
00042	0.000	100.0	U0	Shillong					

Unsexed individuals and individuals past their prime were excluded from the pairing choices from table 5.4 while carrying out pairings. The results of pairings are presented in table 5.5. All the pairs show an inbreeding coefficient of 0.000 indicating no inbreeding would occur as a result of the pairings. Thus it is possible to pair any of the animals. However, while implementing pairings due consideration must be given to mutual compatibility, relocation of animals and formation of social groups.

Table 5.5 : Pairs recommended for breeding

Sire	Dam	Inbreeding coefficient	Sire	Dam	*Inbreeding coefficient*
00013	00005	0.000	00028	00018	*0.000*
00013	00010	0.000	00028	00023	*0.000*
00013	00011	0.000	00028	00024	*0.000*
00013	00012	0.000	00028	00027	*0.250*
00013	00014	0.000	00028	00030	*0.000*
00013	00015	0.000	00028	00038	*0.000*
00013	00018	0.000	00029	00005	*0.000*
00013	00023	0.000	00029	00010	*0.000*
00013	00024	0.000	00029	00011	*0.000*
00013	00027	0.000	00029	00012	*0.000*
00013	00030	0.000	00029	00014	*0.000*
00013	00038	0.000	00029	00015	*0.000*
00016	00005	0.000	00029	00018	*0.000*
00016	00010	0.000	00029	00023	*0.000*
00016	00011	0.000	00029	00024	*0.000*
00016	00012	0.000	00029	00027	*0.000*
00016	00014	0.000	00029	00030	*0.000*
00016	00015	0.000	00029	00038	*0.000*
00016	00018	0.000	00031	00005	*0.000*
00016	00023	0.000	00031	00010	*0.000*
00016	00024	0.000	00031	00011	*0.000*

Sire	Dam	Inbreeding coefficient	Sire	Dam	*Inbreeding coefficient*
00016	00027	0.000	00031	00012	*0.000*
00016	00030	0.000	00031	00014	*0.000*
00016	00038	0.000	00031	00015	*0.000*
00020	00005	0.000	00031	00018	*0.000*
00020	00010	0.000	00031	00023	*0.000*
00020	00011	0.000	00031	00024	*0.000*
00020	00012	0.000	00031	00027	*0.000*
00020	00014	0.000	00031	00030	*0.000*
00020	00015	0.000	00031	00038	*0.000*
00020	00018	0.000	00032	00005	*0.000*
00020	00023	0.000	00032	00010	*0.000*
00020	00024	0.000	00032	00011	*0.000*
00020	00027	0.000	00032	00012	*0.000*
00020	00030	0.000	00032	00014	*0.000*
00020	00038	0.000	00032	00015	*0.000*
00021	00005	0.000	00032	00018	*0.000*
00021	00010	0.000	00032	00023	*0.000*
00021	00011	0.000	00032	00024	*0.000*
00021	00012	0.000	00032	00027	*0.000*
00021	00014	0.000	00032	00030	*0.000*
00021	00015	0.000	00032	00038	*0.000*
00021	00018	0.000	00033	00005	*0.000*
00021	00023	0.000	00033	00010	*0.000*
00021	00024	0.000	00033	00011	*0.000*
00021	00027	0.000	00033	00012	*0.000*
00021	00030	0.000	00033	00014	*0.000*
00021	00038	0.000	00033	00015	*0.000*
00022	00005	0.000	00033	00018	*0.000*
00022	00010	0.000	00033	00023	*0.000*
00022	00011	0.000	00033	00024	*0.000*
00022	00012	0.000	00033	00027	*0.000*
00022	00014	0.000	00033	00030	*0.000*
00022	00015	0.000	00033	00038	*0.000*
00022	00018	0.000	00034	00005	*0.000*
00022	00023	0.000	00034	00010	*0.000*
00022	00024	0.000	00034	00011	*0.000*
00022	00027	0.000	00034	00012	*0.000*
00022	00030	0.000	00034	00014	*0.000*
00022	00038	0.000	00034	00015	*0.000*
00025	00005	0.000	00034	00018	*0.000*
00025	00010	0.000	00034	00023	*0.000*

Sire	Dam	Inbreeding coefficient	Sire	Dam	*Inbreeding coefficient*
00025	00011	0.000	00034	00024	*0.000*
00025	00012	0.000	00034	00027	*0.000*
00025	00014	0.000	00034	00030	*0.000*
00025	00015	0.000	00034	00038	*0.000*
00025	00018	0.000	00036	00005	*0.000*
00025	00023	0.000	00036	00010	*0.000*
00025	00024	0.000	00036	00011	*0.000*
00025	00027	0.000	00036	00012	*0.000*
00025	00030	0.000	00036	00014	*0.000*
00025	00038	0.000	00036	00015	*0.000*
00026	00005	0.000	00036	00018	*0.000*
00026	00010	0.000	00036	00023	*0.000*
00026	00011	0.000	00036	00024	*0.000*
00026	00012	0.000	00036	00027	*0.000*
00026	00014	0.000	00036	00030	*0.000*
00026	00015	0.000	00036	00038	*0.000*
00026	00018	0.000	00037	00005	*0.000*
00026	00023	0.000	00037	00010	*0.000*
00026	00024	0.000	00037	00011	*0.000*
00026	00027	0.000	00037	00012	*0.000*
00026	00030	0.000	00037	00014	*0.000*
00026	00038	0.000	00037	00015	*0.000*
00028	00005	0.000	00037	00018	*0.000*
00028	00010	0.000	00037	00023	*0.000*
00028	00011	0.000	00037	00024	*0.000*
00028	00012	0.000	00037	00027	*0.000*
00028	00014	0.000	00037	00030	*0.000*
00028	00015	0.000	00037	00038	*0.000*

ONE HORNED RHINOCEROS

BIOLOGY AND STATUS

Taxonomy

Kingdom	:	Animalia
Phylum	:	Chordata
Class	:	Mammalia
Order	:	Perrisodactyla
Family	:	Rhinocertidae
Scientific Name	:	*Rhinoceros unicornis*
Species Authority	:	Linnaeus 1758
Common Name/s	:	Gainda (Hindi)

Morphometry

Shoulder height	:	1.75 - 2 metres
Length	:	3- 3.8 metres
Weight	:	1,800 - 2,700 kg,

Distribution

Distributed in several pockets with large populations occurring in Kaziranga National Park, India and Chitwan National Park, Nepal and much smaller populations occurring in Pobitora, Orang, Jaldapara, Gorumara and Manas Wildlife Sanctuaries in India.

Habitat

Inhabits riverine grasslands of the Terai and Brahmaputra basins. The species prefers alluvial plain grasslands, but is also found in adjacent swamps and forests.

Diet

The diet includes mainly grasses, but also some fruit, leaves, shrub and tree branches, and cultivated crops

Sexual maturity

♂ 8-10 years; ♀ 5-7 years

Gestation Period

465-490 days

Longevity

30-35 years in wild; upto 47 years in captivity)

Threats

The present populations are threatened by poaching and decline in habitat quality. Conversion of alluvial plain grasslands to agricultural lands and sports hunting.

Status

The present populations are threatened by poaching and decline in habitat quality. The species is listed in Vulnerable in the version 2009.1 of the IUCN Red List of Threatened Species Schedule 1 of the Wildlife Protection Act (1972) Government of India and in CITES Appendix I since 1975.

Results & discussion

The population status of the living one horned rhinoceros captive population in Indian zoos is presented below in table 6.1. The total number of specimens in captivity across time in India is 135 (76.59.0). Of these 32 specimens are of wild origin and 18 of them have contributed to the gene pool of the captive population.

Table 6.1 : Status of One horned rhinoceros in Indian Zoos

Sl. No.	Zoo Name	Male	Female	Total
1.	Assam State Zoo, Guwahati	4	2	6
2.	Alipore Zoological Garden	1	1	2
3.	National Zoological Park	0	2	2
4.	Nehru Zoological Park	0	1	1
5.	Kanpur Zoological Park	3	2	5
6.	Lucknow Zoological Gardens	1	0	1
7.	Nandankanan Biological Park	1	0	1
8.	Sanjay Gandhi Biological Park	4	6	10
9.	Bhagwan Birsa Bilogical Park	0	1	1
10.	Sepahijala Zoological Park	1	0	1
11.	Trivandrum Zoo	2	0	2
12.	Veermata Jijabai Bhosle Udyan	1	0	1
	Total	**18**	**15**	**33**

Based on data provided by zoos

Census and Demography

The current captive population of one horned rhinos in Indian zoos dates back to 1944 when the first specimen, a female was brought into captivity. The first male entered the captive population in 1952 and the first captive birth was recorded in 1960. The details of census are provided in fig. 6.1.

The age structure of the living population of one horned rhinoceros in captivity (fig. 6.2) suggests that the presence of individuals in each class is essential for a stable population. If rapid population growth is targeted then the number of individuals in the lower age classes should be high i.e. a high birth rate is required.

The mortality rate (Qx) (fig. 6.3) for males and females peak in the first year of life. Additional peaks are observed once again in the 21st, 29th and 33rd years in males and 21st, 27th, 33rd, 34th, 36th and 40th year in females. Fecundity (Mx) (fig. 6.4) in males peaks in the 10th year and in females in the 11th, 14th and 17th year of life. Special care must be taken in young calves to reduce the mortality rates in the 1st year of life. For breeding purposes attempts must be made to use the peak reproductive time in the life span of the captive individuals.

The projected population growth rates of the population as determined by analysis of the life table are depicted in table 6.2. It shows that the captive one horned rhinoceros population in Indian zoos is declining. All the indices used to measure population growth show negative trends

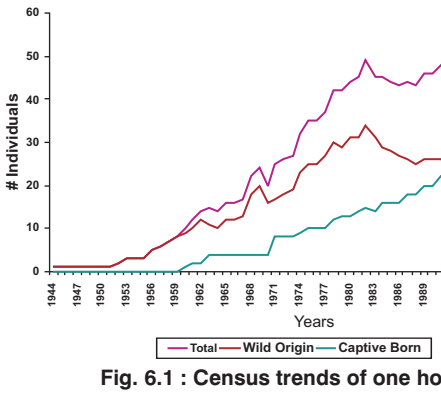

Fig. 6.1 : Census trends of one horned rhinoceros in captivity

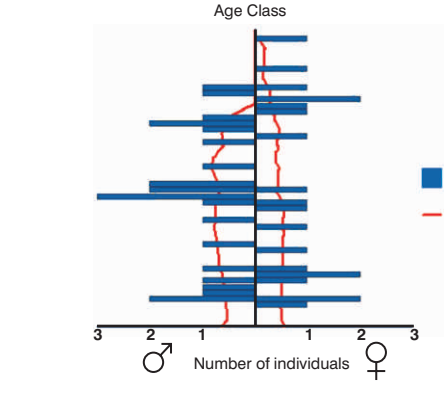

Fig. 6.2 : Age distribution of captive one horned rhinoceros

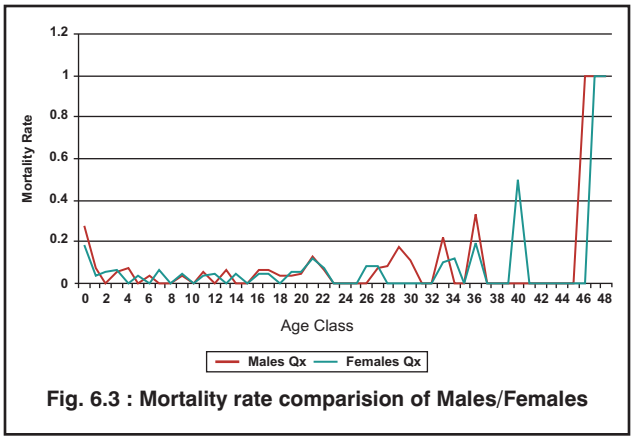

Fig. 6.3 : Mortality rate comparision of Males/Females

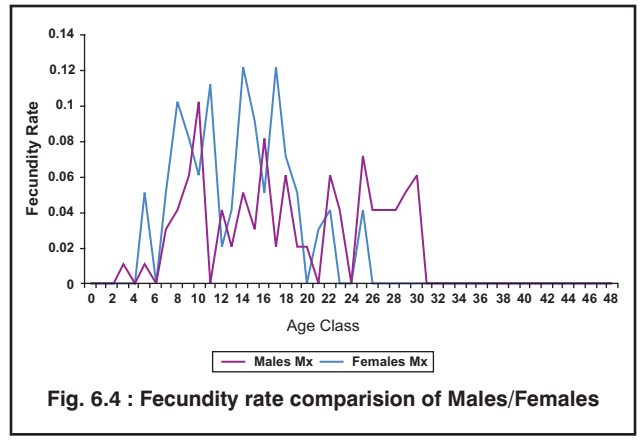

Fig. 6.4 : Fecundity rate comparision of Males/Females

Table 6.2 : Projected population growth rates

	Males	Females
r	-0.0499	-0.0342
lambda	0.9514	0.9664
R_0	0.368	0.602
T	20.05	14.86

Genetic Summary

The genetic summary of the captive one horned rhinoceros Indian population is presented in table 6.3. The table suggests that the genetic variability of the population could be much higher than that at present.

Table 6.3 : Genetic Summary

	Current	Potential
Founders	18	14 additional
Founder genome equivalents	7.18	26.96
Founder genome surviving	11.29	26.96
Gene diversity retained	0.93	0.982
Population mean kinship	0.07	0.018
Mean inbreeding	0.04	0.018
Ne / N	0.33	-----
% of pedigree known	91	-----

An analysis of the founder representation of the Indian captive one horned rhinoceros population presented in figure 6.5 depicts the contribution made by each specimen of wild origin to the captive population. It is inferred that a few individuals (studbook numbers - 7, 8, 26, 34, 36, 49, 62 and 65) are over represented while others are underrepresented or not represented at all. An equal representation of all founder animals could have significantly enhanced the genetic variability of the current population.

The inbreeding statistics of the Indian captive one horned rhinoceros suggest that studbook numbers

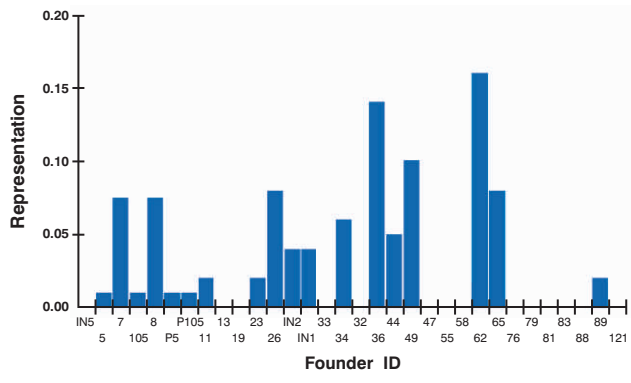

Fig. 6.5 : Founder representation of captive one horned rhinoceros

99, 108, 120, and 124 have significant levels of inbreeding coefficient and they or their offspring would carry a smaller portion of the gene pool that can be represented in individual specimens. These individuals should be used with caution for breeding purposes only when absolutely necessary.

Population Planning and Breeding Recommendations

Population modeling of the captive Indian one horned rhinoceros was carried out using PM2000. Based on this analysis, it is envisaged that a population of 100 individuals to be achieved over a span of 10 years for the Indian captive population would allow the maintenance of a genetically viable and demographically stable captive population. The demographic and genetic management strategy for the population is summarized in table 6.4. It suggests that with a population growth rate of 1.013 and a generation length of 17.5 years the population can achieve the target of 100 specimens in the next 10 years. The maintenance of the desired level of genetic diversity in the captive population can be achieved by the addition of 1 founder each for the next 10 years. This would allow the maintenance of 90% genetic diversity at the end of 50 years (Figure 6.6).

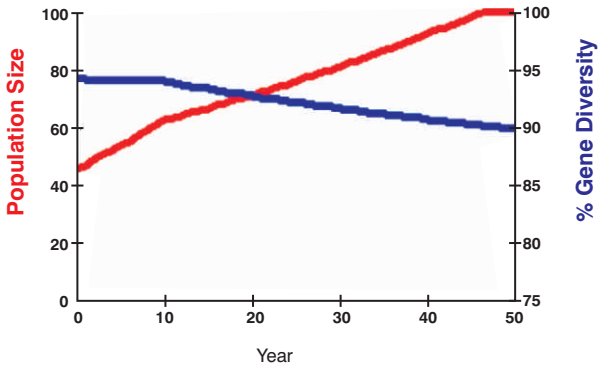

Fig. 6.6 : Demographic & genetic management strategy

Table 6.4 : Management Strategy Table

	Planned
Generation length	17.5
Population growth rate	1.013
Ne / N ratio	0.32
Initial gene diversity	0.944
Target population size	100
# New founders needed	1
Year to Stop Adding Founders	10
Years Between Addition Events	1
FGE Recruited per New Founder	0.40

Hypothetical pairings were carried out using the pairings options of PM 2000 from the ordered list of mean kinship of live individuals (table 6.5). The animals used for pairing are listed in table 6.6, the column headed by "may be bred with" contains all those animals which can possibly be used for pairing. While the column headed by "may not be bred with" contains animals which if used for pairing would produce inbred offspring. While carrying out the pairings due attention must be given to the facts that all founder animals get an equal chance of contributing to the gene pool and the animals have to be moved a minimal distance to implement such mating choices. Animals past their breeding age and animals that had been transferred out of India were excluded for pairing (table 6.7).

Table 6.5 : Ordered Mean kinship of living individuals

	Males					Females				
Rank	Studbook No.	Mean	% Kinship	Age Known	Location	Studbook	Mean No.	% Kinship	Age Known	Location
1	IN5	0.0000	100.0	0	Nagoya	13	0.0000	100.0	47	Hyderabad
2	47	0.0000	100.0	33	Nandankanan	19	0.0000	100.0	42	Mysore
3	55	0.0000	100.0	32	Veermata	33	0.0000	100.0	37	Ny Bronx
4	58	0.0000	100.0	30	Assam	32	0.0000	100.0	37	Calcutta
5	76	0.0000	100.0	23	Calcutta	5	0.0050	100.0	59	Paris
6	79	0.0000	100.0	22	Trivandrum	89	0.0100	100.0	20	Assam
7	81	0.0000	100.0	22	Trivandrum	28	0.0200	100.0	39	Whipsnade
8	83	0.0000	100.0	21	Jaldapara	54	0.0200	100.0	31	Singapore
9	88	0.0000	100.0	20	Tripura	IN7	0.0300	100.0	35	Toronto
10	121	0.0000	100.0	13	Kanpur	112	0.0413	100.0	8	Assam
11	44	0.0250	100.0	34	Assam	100	0.0600	100.0	12	Delhi
12	IN3	0.0300	100.0	39	Ny Bronx	36	0.0700	100.0	36	Ranchi
13	29	0.0475	100.0	38	Nagoya	124	0.0700	100.0	4	Delhi
14	82	0.0475	100.0	21	Assam	114	0.0925	100.0	8	Patna
15	49	0.0500	100.0	33	Patna	127	0.0925	100.0	3	Patna
16	72	0.0513	100.0	26	Lucknow	92	0.0950	100.0	19	Patna
17	77	0.0525	100.0	23	Assam	118	0.0981	100.0	7	Kanpur
18	93	0.0600	100.0	17	Patna	80	0.1150	100.0	22	Patna
19	85	0.0613	100.0	21	Kanpur	108	0.1175	100.0	16	Kanpur
20	119	0.0700	100.0	6	Sandiegozoo	116	---	---	9	Patna
21	123	0.0825	100.0	4	Patna	125	---	---	4	Patna
22	111	0.0925	100.0	9	Sandiegozoo					
23	117	0.0925	100.0	7	Sandiegozoo					
24	126	0.0981	100.0	4	Kanpur					
25	120	0.1025	100.0	5	Patna					
26	102	---	---	0	Losangeles					

Table 6.6 : Pairings used for determining breeding recommendations

Studbook No.	Location	Sex	Age	May be bred with	May not be bred with
44	Assam	M	34	127, 124, 125, 118, 114, 116, 100, 108, 92, 89, 80	112
47	Nandankanan	M	33	127, 124, 125, 118, 112, 114, 116, 100, 108, 92, 89, 80	
49	Patna	M	33	124, 125, 118, 112, 116, 100, 108, 92, 89, 80	127, 114
55	Veermata	M	32	127, 124, 125, 118, 112, 114, 116, 100, 108, 92, 80	
58	Assam	M	30	127, 124, 125, 118, 112, 114, 116, 100, 108, 92, 89, 80	

Studbook No.	Location	Sex	Age	May be bred with	May not be bred with
72	Lucknow	M	26	127, 124, 125, 114, 116, 100, 108, 92, 89, 80	118, 112
76	Calcutta	M	23	127, 124, 125, 118, 112, 114, 116, 100, 108, 92, 89, 80	
77	Assam	M	23	127, 124, 125, 114, 116, 100, 108, 92, 89, 80	118, 112
79	Trivandrum	M	22	127, 124, 125, 118, 112, 114, 116, 100, 108, 92, 89, 80	
80	Patna	F	22	44, 47, 49, 55, 58, 72, 76, 77, 79, 81, 82, 85, 88, 93, 120, 121, 123, 126	
81	Trivandrum	M	22	127, 124, 125, 118, 112, 114, 116, 100, 108, 92, 89, 80	
82	Assam	M	21	127, 124, 125, 114, 116, 100, 108, 92, 89, 80	118, 112
85	Kanpur	M	21	127, 124, 125, 114, 116, 100, 108, 92, 89, 80	118, 112
88	Tripura	M	20	127, 124, 125, 118, 112, 114, 116, 100, 108, 92, 89, 80	
89	Assam	F	20	44, 47, 49, 58, 72, 76, 77, 79, 81, 82, 85, 88, 93, 120, 121, 123, 126	
92	Patna	F	19	44, 47, 49, 55, 58, 72, 76, 77, 79, 81, 82, 85, 88, 93, 120, 121, 123, 126	
93	Patna	M	17	127, 125, 118, 112, 114, 116, 108, 92, 89, 80	124, 100
100	Delhi	F	12	44, 47, 49, 55, 58, 72, 76, 77, 79, 81, 82, 85, 88, 93, 120, 121, 123, 126	
108	Kanpur	F	16	44, 47, 49, 55, 58, 72, 76, 77, 79, 81, 82, 85, 88, 93, 120, 121, 123, 126	
112	Assam	F	8	44, 47, 49, 55, 58, 72, 76, 77, 79, 81, 82, 85, 88, 93, 120, 121, 123, 126	
114	Patna	F	8	44, 47, 49, 55, 58, 72, 76, 77, 79, 81, 82, 85, 88, 93, 120, 121, 123, 126	
116	Patna	F	9	44, 47, 49, 55, 58, 72, 76, 77, 79, 81, 82, 85, 88, 93, 120, 121, 123, 126	
118	Kanpur	F	7	44, 47, 49, 55, 58, 72, 76, 77, 79, 81, 82, 85, 88, 93, 120, 121, 123, 126	
120	Patna	M	5	124, 125, 118, 112, 116, 100, 89	127, 114, 108, 92, 80
121	Kanpur	M	13	127, 124, 125, 118, 112, 114, 116, 100, 108, 92, 89, 80	
123	Patna	M	4	124, 125, 112, 116, 100, 89	127, 118, 114, 108, 92, 80
124	Delhi	F	4	44, 47, 49, 55, 58, 72, 76, 77, 79, 81, 82, 85, 88, 93, 120, 121, 123, 126	
125	Patna	F	4	44, 47, 49, 55, 58, 72, 76, 77, 79, 81, 82, 85, 88, 93, 120, 121, 123, 126	
126	Kanpur	M	4	127, 124, 125, 116, 100, 89	118, 112, 114, 108, 92, 80
127	Patna	F	3	44, 47, 49, 55, 58, 72, 76, 77, 79, 81, 82, 85, 88, 93, 120, 121, 123, 126	

Table 6.7 : Animals excluded from pairings

Studbook No.	Location	Sex	Age
5	Paris	F	59
13	Hyderabad	F	47
19	Mysore	F	42
28	Whipsnade	F	39
29	Nagoya	M	38
32	Calcutta	F	37
33	Ny Bronx	F	37
36	Ranchi	F	36
54	Singapore	F	31
83	Jaldapara	M	21
102	Losangeles	M	0
111	Sandiegozoo	M	9
117	Sandiegozoo	M	7
119	Sandiegozoo	M	6
IN3	Ny Bronx	M	39
IN5	Nagoya	M	0
IN7	Toronto	F	35

GAUR
(INDIAN BISON)

BIOLOGY AND STATUS

Taxonomy

Kingdom	:	Animalia
Phylum	:	Chordata
Class	:	Mammalia
Order	:	Cetartiodactyla
Family	:	Bovidae
Scientific Name	:	*Bos gaurus*
Species Authority	:	C.H. Smith, 1827
Common Name/s	:	Gaur, indian bison

Morphometry

Shoulder height	:	1.6 - 1.9 m
Weight	:	1,800 - 2,700 kg,

Distribution

The current distribution is restricted to scattered pockets in India, Nepal, Bhutan, Cambodia, China, Lao PDR, Peninsular Malaysia, Myanmar, Thailand and Vietnam.

Habitat

Inhabit a wide variety of habitats ranging from tropical wet, semi-wet evergreen and bamboo forests, tropical moist deciduous, to tropical dry deciduous forests in Central India to Shola forests and tropical thorn forests on the eastern slopes in the Western Ghats.

Diet

They are both grazers and browsers that feed on a variety of plant species. Incidents of debarking are also recorded. They are known to frequent salt licks.

Sexual maturity

2 - 3 years of age

Gestation Period

275 days

Number of offspring

1-2

Weaning

7-9 months

Longevity

Upto 30 years

Threats

Poaching, habitat loss and fragmentation are threats which are ubiquitous. In northeast India the species is threatened with habitat degradation brought about by shifting cultivation. In the rest of its range forest conversion for agricultural use and commercial plantations are a serious threat. The species is closely related to domestic livestock and is vulnerable to all the livestock diseases.

Status

The global population of Gaur is estimated at 13,000 - 30,000 animals, of these only 5,200 - 18,000 are reproductively active individuals. The populations have declined overall by at least 30% during the last three generations. As a consequence they are categorized as Vulnerable (Criteria A2cd+3cd+4cd ver 3.1) of the IUCN Red List of Threatened species, 2009. They are listed in Schedule-I of the Indian Wildlife (Protection) Act of 1972 and are included in the Appendix I of the Conservation on International trade in Endangered Species of Wild Fauna and Flora (CITES). V

Results & discussion

The population status of living individuals of Gaur in Indian zoos is presented in table 7.1 below. The current Indian captive population has 67 (35.31.1) specimens spread across 9 zoos in the country. The total number of specimens included in the studbook is 93; of which 8 specimens are of wild origin, and 7 have successfully produced offspring.

Table 7.1 : Status of Indian Bison in Indian Zoos

Zoo Name	Male	Female	Unsexed	Total
Bannerghata Biological Park, Bangalore	7	3	1	11
M.C. Zoological Park, Chatbir	0	1	0	1
National Zoological Park, New Delhi	2	2	0	4
Arignar Anna Zoological Park, Chennai	4	5	0	9
Sri Chamarajendra Zoological Park, Mysore	13	13	0	26
Rajiv Gandhi Zool. Park & Res. Ctr, Pune	1	1	0	2
Sepahijala Zoological Park, Agartala	1	0	0	1
Bondla Zoo, Usgown, Goa	5	4	0	9
Indira Gandhi Zoologicalm Park, Visakhapatnam	2	2	0	4
Total	**35**	**31**	**1**	**67**

Based on data provided by zoos

Census and Demography

The first animal of known wild origin for which records are available entered the captive population in 1988 in Nehru Zoological Park, Hyderabad; subsequently six additional animals of wild origin entered the captive program over the years, with the last animal entering the captive program in 2004 in Sri Chamarajendra Zoological Park, Mysore. The details of census are presented in fig. 7.1.

From the age pyramid (fig. 7.2) the results obtained for stable age distribution suggest that while for males it is essential to have a larger proportion of individuals in the younger/ reproductive ages and a few or none in the higher age classes. For females an elongated bell shaped curve is obtained which suggests that equitable distribution of individuals in all age class with a gradual decline in numbers in post reproductive age classes, is essential for maintaining a stable population. The age distribution of the population shows that a majority of the individuals in the population are in the reproductive age class, thus with appropriate management the population can be used for rapid growth to achieve population targets. Population growth rates and mortality

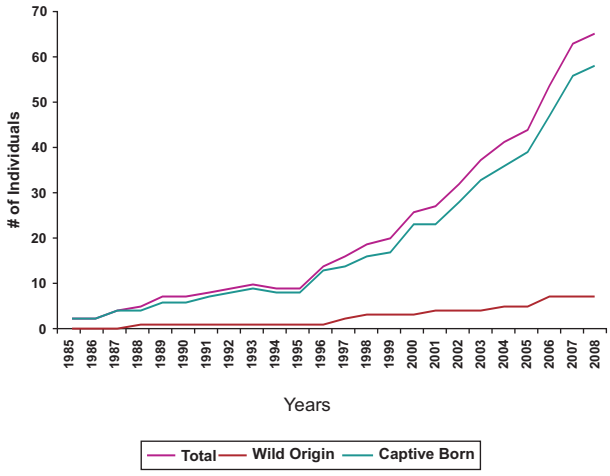

Fig. 7.1 : Census trends of captive population

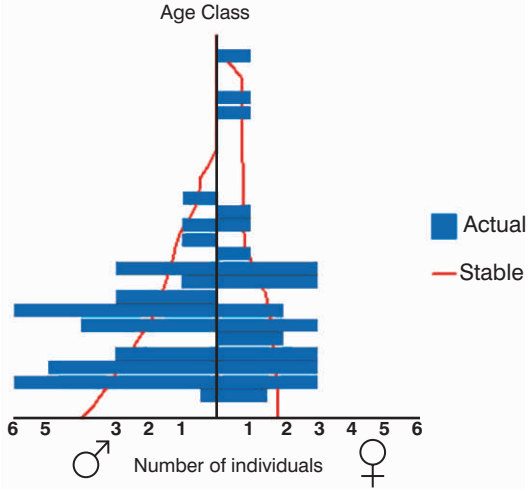

Fig. 7.2 : Age distribution of captive Gaurs

and fecundity rates calculated from male and female life tables are presented in table 7.2 and figs. 7.3 and 7.4 respectively. Mortality in males peaks in the 14th year of life and in the living population the oldest male is of 15 years; whereas in females mortality peaks in the 11th year of life and the oldest living female is of 25 years. Males initiate reproductive activity in the 3rd year and distinct peaks are observed in the 7th, 11th and 13th years. A plateau with high reproductive activity is observed from the 15th - 17th years while a peak is observed in the 18th year. This may be attributed to the fact that only dominant large males may be surviving to these age classes. In females reproductive activity is initiated in the 2nd year of life and shows alternate peaks and troughs till the 11th year. This may be attributed to the long gestation period and weaning time and the need for females to recoup from previous calving.

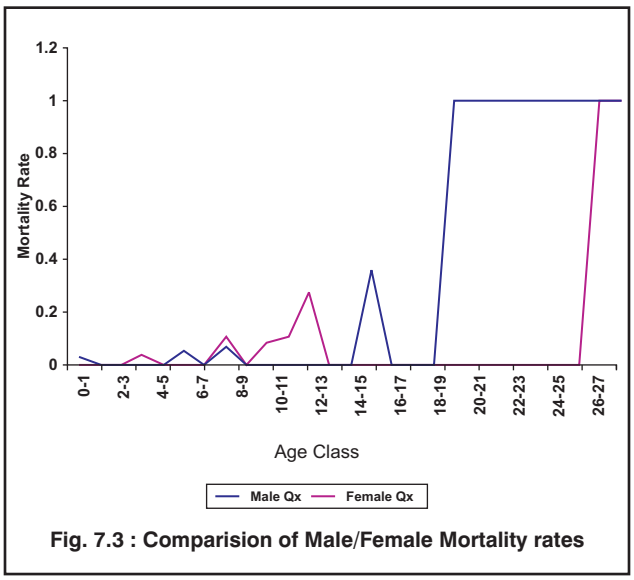

Fig. 7.3 : Comparision of Male/Female Mortality rates

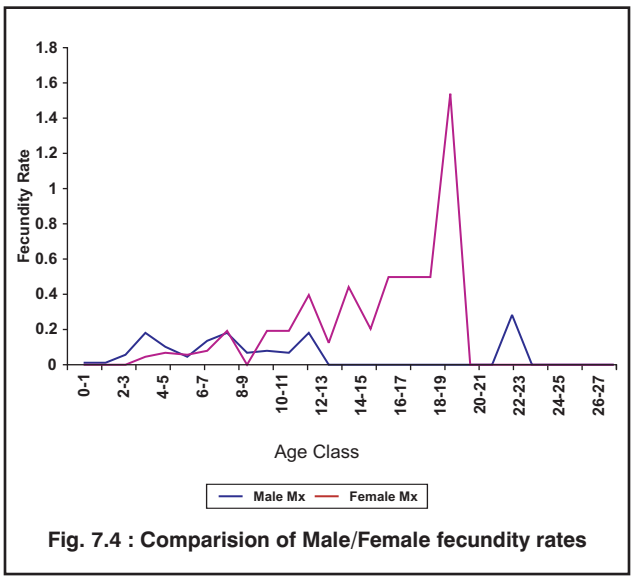

Fig. 7.4 : Comparision of Male/Female fecundity rates

Table 7.2 : Projected population growth rates

	Males	Females
r	0.0877	0.0097
lambda	1.0917	1.0097
R_0	2.743	1.083
T	11.50	8.22

Table 7.3 : Genetic Status Table

	Current	Potential
Founders	7	1 additional
Founder genome equivalents	3.55	7.94
Founder genome surviving	5.16	7.94
Gene diversity retained	0.859	0.937
Population mean kinship	0.141	0.063
Mean inbreeding	0.175	0.063
Ne / N	0.33	-----
% of pedigree known	58	-----

Genetic Summary

Table 7.3 summarizes the genetics of captive Gaur population. The gene diversity retained in the present population is 0.859, and the potential gene diversity of this population could have been 0.937 had all founders contributed equally to the population.

The founder representation in the captive Indian bison population is presented in fig. 7.5. The studbook numbers 00024, 00005 and 00028 are over represented in the population whereas 00064, 00007, 00062 and 00063 are under represented; 00041 is not represented at all.

The inbreeding statistics of the captive Indian bison population were calculated using PM2000. Specimens with studbook numbers 00019, 00027, 00033, 00039, 00040, 00050, 00053, 00061 and 00071 have significant levels of inbreeding. They or their offspring should accordingly not be used for breeding purposes as they contain a much reduced sample of the original gene pool and their use in breeding would cause an accelerated loss of genetic diversity.

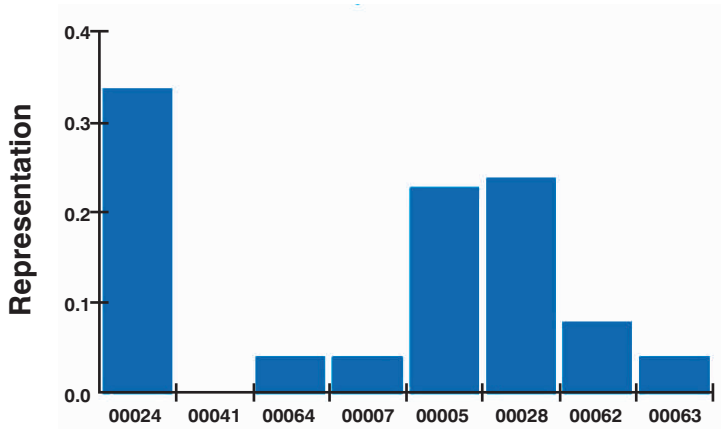

Fig. 7.5 : Founder representation in captive Gaur

Table 7.4 : Management Strategy Table

Variables	Planned
Mean Generation length	9.9
Population growth rate	1.05
Ne / N ratio	0.32
Initial gene diversity	0.89
Target population size	123
Maximum Allowable Population Size	150
New Founders per Addition Event	2
Year to Start Adding Founders	1
Year to Stop Adding Founders	15
Years Between Addition Events	1
FGE Recruited per New Founder	0.400

Population Planning and Breeding Recommendations

The population was modeled using PM 2000 (Ver.1.213). Modeling the current population for minimum population size required to retain 90% genetic diversity at the end of 50 years and be demographically stable at the same gave a result of 123 individuals (table 7.4, fig. 7.6).

Possible pairings were carried out from a listing of ordered mean kinship of live specimens (table 7.5) in the studbook to check for any inbreeding depression and associated loss of genetic diversity in progeny thus produced. Specimens with high mean kinship values, unknown ancestry or past their reproductive prime were excluded from the pairings. The results are presented in table 7.6. While implementing pairings the guiding principle should be the maximal retention of genetic diversity and the minimal distance that the animals have to be moved to implement such pairings.

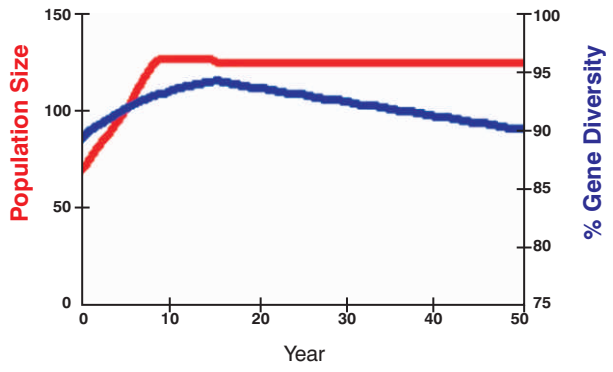

Fig. 7.6 : Population management strategy

Table 7.5 : Ordered mean kinships

Males					Females				
Stbk#	**MK**	**Known**	**Age**	**Location**	**Stbk#**	**MK**	**Known**	**Age**	**Location**
00041	0.0000	100.0	0	Sepahijala	00064	0.0198	100.0	0	Delhi
00063	0.0198	100.0	10	Delhi	00007	0.0198	100.0	22	Bannerghata
00085	0.0396	100.0	2	Delhi	00062	0.0396	100.0	10	Chennai
00077	0.0990	100.0	3	Chennai	00091	0.0990	100.0	1	Chennai
00028	0.1188	100.0	15	Chennai	00078	0.1386	50.0	3	Chennai
00067	0.1386	50.0	4	Chennai	00088	0.1386	50.0	2	Chennai
00076	0.1386	50.0	3	Mysore	00039	0.1419	75.0	9	Visakapatnam
00027	0.1419	75.0	12	Visakapatnam	00040	0.1525	62.5	9	Visakapatnam
00052	0.1452	75.0	7	Visakapatnam	00024	0.1683	100.0	0	Usgown
00038	0.1881	50.0	9	Usgown	00075	0.1881	50.0	3	Usgown
00046	0.1881	50.0	7	Usgown	00054	0.1980	50.0	7	Usgown
00086	0.1881	50.0	2	Usgown	00071	0.2030	50.0	4	Usgown
00061	0.1947	75.0	6	Usgown	00002	---	---	25	Delhi
00032	0.2079	50.0	10	Usgown	00037	---	---	9	Chennai
00087	---	---	2	Pune	00092	---	---	2	Pune
00020	---	---	13	Bannerghata	00010	---	---	21	Bannerghata
00034	---	---	10	Mysore	00018	---	---	14	Mysore
00043	---	---	8	Bannerghata	00026	---	---	13	Mysore
00044	---	---	8	Bannerghata	00031	---	---	11	Mysore
00045	---	---	8	Bannerghata	00035	---	---	10	Mysore
00047	---	---	7	Bannerghata	00036	---	---	10	Mysore
00048	---	---	7	Bannerghata	0053	---	---	7	Mysore
00049	---	---	7	Mysore	00057	---	---	6	Mysore
00051	---	---	7	Mysore	00058	---	---	6	Mysore
00055	---	---	6	Mysore	00059	---	---	6	Chatbir Zoo
00056	---	---	6	Bannerghata	00065	---	---	5	Mysore
00060	---	---	6	Chennai	00066	---	---	5	Mysore
00070	---	---	4	Mysore	00073	---	---	4	Mysore
00072	---	---	4	Mysore	00074	---	---	4	Bannerghata
00079	---	---	3	Mysore	00082	---	---	3	Mysore
00080	---	---	3	Mysore	00089	---	---	2	Mysore
00081	---	---	3	Mysore					
00083	---	---	2	Mysore					
00084	---	---	2	Mysore					
00090	---	---	2	Mysore					

Ordered Mean Kinships for Unknown sex animals

Stbk#	MK	Known	Age	Location
00093	0.0396	50.0	1	Bannerghata

Table 7.6 : Summary of Breeding Recommendations

ID	Location	Sex	Breed With
00024	Usgown	Female	00041, 00027, 00028, 00032, 00038, 00046, 00052, 00061, 00063, 00067, 00076, 00077, 00085, 00086
00027	Visakapatnam	Male	00024, 00039, 00040, 00054, 00062, 00064, 00071, 00075, 00078, 00091, 00088
00028	Chennai	Male	00024, 00039, 00040, 00054, 00062, 00064, 00071, 00075, 00078, 00091, 00088
00032	Usgown	Male	00024, 00039, 00040, 00054, 00062, 00064, 00071, 00075, 00078, 00091, 00088
00038	Usgown	Male	00024, 00039, 00040, 00054, 00062, 00064, 00071, 00075, 00078, 00091, 00088
00039	Visakapatnam	Female	00041, 00027, 00028, 00032, 00038, 00046, 00052, 00061, 00063, 00067, 00076, 00077, 00085, 00086
00040	Visakapatnam	Female	00041, 00027, 00028, 00032, 00038, 00046, 00052, 00061, 00063, 00067, 00076, 00077, 00085, 00086
00041	Sepahijala	Male	00064, 00062, 00039, 00040, 00024, 00054, 00071, 00075, 00078, 00091, 00088
00046	Usgown	Male	00024, 00039, 00040, 00054, 00062, 00064, 00071, 00075, 00078, 00091, 00088
00052	Visakapatnam	Male	00024, 00039, 00040, 00054, 00062, 00064, 00071, 00075, 00078, 00091, 00088
00054	Usgown	Female	00041, 00027, 00028, 00032, 00038, 00046, 00052, 00061, 00063, 00067, 00076, 00077, 00085, 00086
00061	Usgown	Male	00024, 00039, 00040, 00054, 00062, 00064, 00071, 00075, 00078, 00091, 00088
00062	Chennai	Female	00041, 00027, 00028, 00032, 00038, 00046, 00052, 00061, 00063, 00067, 00076, 00077, 00085, 00086
00063	Delhi	Male	00024, 00039, 00040, 00054, 00062, 00064, 00071, 00075, 00078, 00091, 00088
00064	Delhi	Female	00041, 00027, 00028, 00032, 00038, 00046, 00052, 00061, 00063, 00067, 00076, 00077, 00085, 00086
00067	Chennai	Male	00024, 00039, 00040, 00054, 00062, 00064, 00071, 00075, 00078, 00091, 00088
00071	Usgown	Female	00041, 00027, 00028, 00032, 00038, 00046, 00052, 00061, 00063, 00067, 00076, 00077, 00085, 00086
00075	Usgown	Female	00041, 00027, 00028, 00032, 00038, 00046, 00052, 00061, 00063, 00067, 00076, 00077, 00085, 00086
00076	Mysore	Male	00024, 00039, 00040, 00054, 00062, 00064, 00071, 00075, 00078, 00091, 00088
00077	Chennai	Male	00024, 00039, 00040, 00054, 00062, 00064, 00071, 00075, 00078, 00091, 00088
00078	Chennai	Female	00041, 00027, 00028, 00032, 00038, 00046, 00052, 00061, 00063, 00067, 00076, 00077, 00085, 00086
00085	Delhi	Male	00024, 00039, 00040, 00054, 00062, 00064, 00071, 00075, 00078, 00091, 00088
00086	Usgown	Male	00024, 00039, 00040, 00054, 00062, 00064, 00071, 00075, 00078, 00091, 00088
00091	Chennai	Female	00041, 00027, 00028, 00032, 00038, 00046, 00052, 00061, 00063, 00067, 00076, 00077, 00085, 00086

WILD DOG

BIOLOGY AND STATUS

Taxonomy

Kingdom	:	Animalia
Phylum	:	Chordata
Class	:	Mammalia
Order	:	Carnivore
Family	:	Canidae
Scientific Name	:	*Cuon alpinus*
Species Authority	:	*(Pallas, 1811)*
Common Name/s	:	Dhole, Red dog, Ban kutta

Morphometry

Body weight : 17 to 21 Kg

Distribution

Found in parts of south China, Tibet, Ladakh in India, throughout most of India south of the Gangetic river basin, north-east India, Bangladesh; Bhutan; Cambodia; China; India; Indonesia; Kazakhstan; Kyrgyzstan; Malaysia; Mongolia; Myanmar; Nepal; Russian Federation; Tajikistan; Thailand; Vietnam.

Habitat

Inhabits a wide variety of vegetation types, including: primary, secondary and degraded forms of tropical dry and moist deciduous forest; evergreen and semi-evergreen forests; dry thorn forests; grassland-scrub- forest mosaics; and alpine steppe (above 3,000m a.s.l.). In India, tropical dry and moist deciduous forest are considered to represent optimal habitats and believed to hold the largest dhole populations.

Diet

Their diet consists of goat, sheep, monkey, deer, rodents, wild berries, wild pigs, lizards, and insects.

Sexual maturity

1.5 year

Mating season

Mating activity is initiated in November and continues till April with a peak during December and January

Gestation Period

60 - 62 days

Litter Size

2 - 6 pups

Weaning

6-7 weeks

Longevity

≅16 years

Group size & structure

Lives in pack of 5-10 individuals, but packs of 30 or even more animals have been recorded. Groups have a strong hierarchical structure, with a dominant male and female who are the main, or sole breeders.

Threats

Habitat loss and degradation of forest resulting in loss of cover. Besides this, disease and pathogens of canids are the other major threats to dholes.

Status

Ranked as endangered [criterion (C2a(i))] in IUCN Red list of Threatened species, version 2010.1 and Schedule I of the Wild Life Protection Act; Govt. of India and also included in CITES Appendix II. They are also protected by legislation in most of its range countries.

Results & discussion

The dhole population in Indian zoos owes its origin to wild caught founders. The present population of thirty-eight specimens consists of ten wild caught individuals and twenty-eight captive born individuals the census of the living population is summarized in table 8.1. Across time a total of 41 individuals have been kept in captivity.

Table 8.1 : Status of dholes in Indian zoos

Zoo Name	Males	Females	Total
Arignar Anna Zoological Park, Chennai	9	10	19
Sri Chamarajendra Zoological Park, Mysore	2	2	4
Sri. Venkateswara Zoological Park, Tirupati	2	2	4
Indira Gandhi Zoological Park, Vishakapatnam	5	4	9
Nehru Zoological Park, Hyderabad	0	2	2
Total	**18**	**20**	**38**

Census and Demography

The annual census trend of dholes in captivity in Indian zoos is presented in fig. 8.1. A total of 10 wild origin founders were brought into captivity the other 31 specimens are the offspring of these founder animals.

The results of age pyramid (fig. 8.2) suggest that the recruitment rate in the population is too low to maintain a demographically stable population. No individuals are present in the 0-1 and 1-2 year age classes, whereas it is desirable to have a larger number of individuals in the lower age classes relative to the reproductive and post reproductive age classes. This is to achieve a population growth as the individuals in these age classes are potential breeders that can contribute maximum to the gene pool of the population.

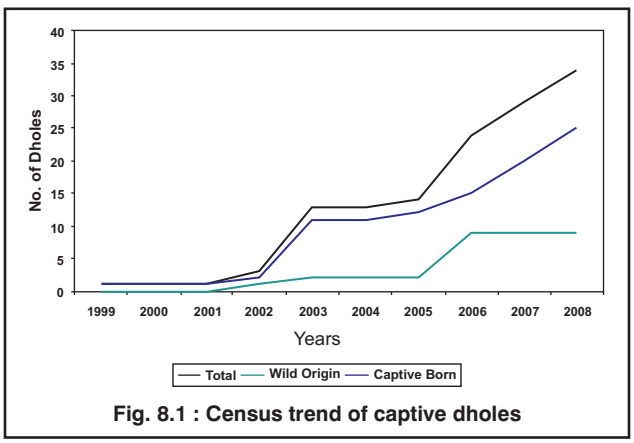

Fig. 8.1 : Census trend of captive dholes

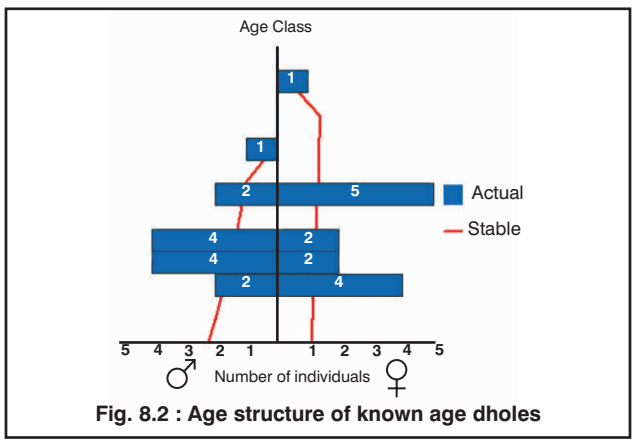

Fig. 8.2 : Age structure of known age dholes

Table 8.2 : Projected population growth rates

	Males	Females
T	3.589	3.391
R_o	1.460	0.920
lambda	1.11	0.98
r	0.105	-0.025

Demographic analysis revealed males to have a positive growth rate compared to females that showed a decline (table 8.2). Demographic analysis revealed the presence of few individuals of known age to be present in the captive population it is thus not possible to draw conclusive inferences on the mortality and fecundity rates of the population.

Genetic Summary

Though attempts were made to carry out genetic analysis using PM 2000, however, the presence of a large number of individuals of unknown ancestry and dates of birth were limitations to analysis. It is suggested that a molecular genetic analysis to ascertain the parentage/ relatedness of individuals be carried out and based on this analysis the pairings of individuals can be decided upon.

INDIAN WILD ASS

BIOLOGY AND STATUS

Taxonomy	Kingdom	: Animalia
	Phylum	: Chordata
	Class	: Mammalia
	Order	: Perissodactyla
	Family	: Equidae
	Scientific Name	: *Equus hemionus ssp. khur*
	Infra-specific Authority	:(Lesson, 1827)
	Common Name/s (Gujarati)	: Indian wild ass, Khur, Ghorkhar or Ghorkhad
Morphometry	Height	: 110-120 cm
	Weight	: 250-290 kg
Distribution	Restricted to the Little Rann of Kutch (Wild Ass Sanctuary) in Gujarat and in adjoining districts	
Habitat	Scrubland with low to medium density of shrubs primarily *Prosopis juliflora* and Rann grassland are the most preferred habitat. Also occupy saline mudflats, grassland, bets (vegetated islands on the barren Rann), and the fringes where natural vegetation is interspersed with croplands	
Diet	Generalist herbivores; they effectively utilize coarse plants being hindgut fermenters	
Breeding season	Predominantly during monsoon	
Gestation Period	11 months	
Number of offspring	1	
Group structure & size	Females with young tend to live in small groups of 2 - 5 adults.	
Threats	Single small population threatened with disease outbreaks, natural calamities and anthropogenic activities	
Status	Current estimates suggest a population of approximately 4000 individuals. Listed as EN Endangered B1ab(iii,v)C2a(ii) by the IUCN Red List and in Schedule I of the Wildlife Protection Act (1972)	

Results & discussion

Only two institutions in India presently house the Wild Ass, there are thus a total of 12 (7.5.0) animals currently in captivity. In historical perspective 82 individuals have so far been kept in captivity.

Table 9.1 : Status of Indian Wild Ass in Indian Zoos as on 31st March 2008

Zoo Name	Male	Female	Unsexed	Total
National Zoological Park, Delhi	1	0	0	1
Sakkarbaug Zoo, Junagadh	6	5	0	11
Total	**7**	**5**	**0**	**12**

Census and Demography

The captive Indian Wild Ass population originates from individuals captured/rescued from the wild. Of the 70 individuals listed in the present studbook as many as 51 individuals are of wild origin. The population was initiated in 1958, since its inception the population has been unstable with a low growth rate (lambda) which at times has dipped below 1 indicating a negative growth rate. Census details have been provided in fig. 9.1.

The age distribution (fig. 9.2) of the captive Indian wild ass population suggests that there are very few females in the reproductive age classes, this absence may also be responsible for low levels of population growth. However, known age individuals form a very small part of the total captive population of Indian wild ass, the age distribution is therefore not a true reflection of the captive population.

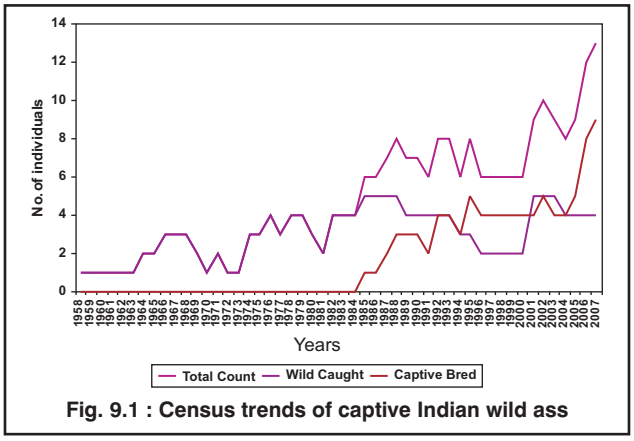

Fig. 9.1 : Census trends of captive Indian wild ass

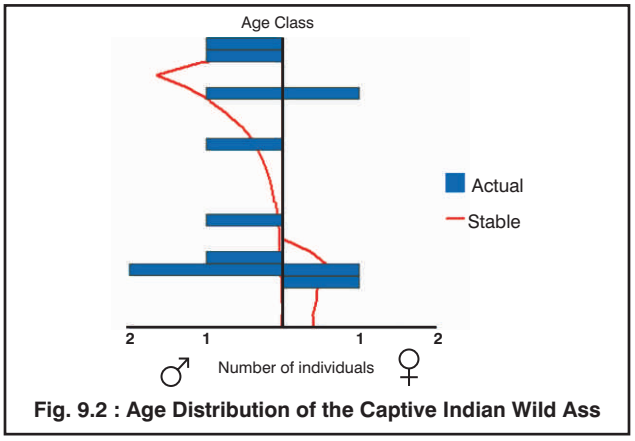

Fig. 9.2 : Age Distribution of the Captive Indian Wild Ass

Table 9.2 : Projected population growth rates

	Males	Females
r	-0.2712	0.2364
lambda	0.7624	0.7895
R^0	0.232	0.297
T	5.38	5.14

The projected population growth rates as determined from life table analysis are summarized in table 9.2. The table suggests that the population is declining as all the indices used to measure population growth show declining trends.

Figures 9.3 and 9.4 present the mortality and fecundity rates of the male and female population. An analysis of life tables for males suggests that a mortality peak is recorded in the first year, thereafter a peak is observed in the 7th year. The first successful reproduction by males was observed to occur between the third and fourth year of life and peaked in the fifth year. Thereafter it abruptly stopped. However, the life table is also based on individuals of known age (N = 6) which forms a small percentage of the total population and hence cannot be used for population predictions. The life tables for females suggests that mortality (Qx) is high in the first two years of life and thereafter shows a peak in the 3rd to 4th year and remains as a plateau after the 6th year. Fecundity peaks in the 5th year and then all breeding activity stops as is suggested by the life table. However the predictive use of the life table is limited due to the small sample size (N = 5). The low levels of fecundity of males and females may be due to the absence of individuals in the reproductive age classes. The low population growth rate can also be attributed to the same.

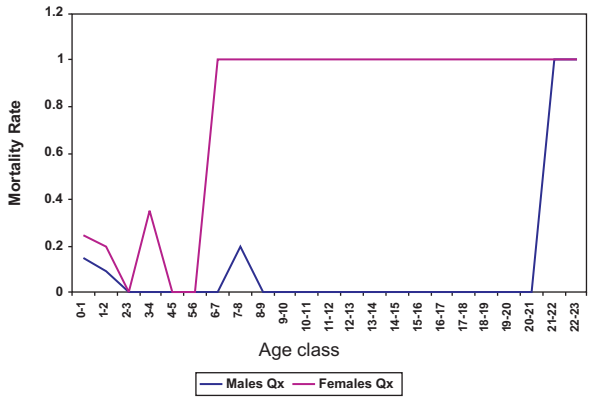

Fig 9.3 : Comparision of Male/Female mortality rates

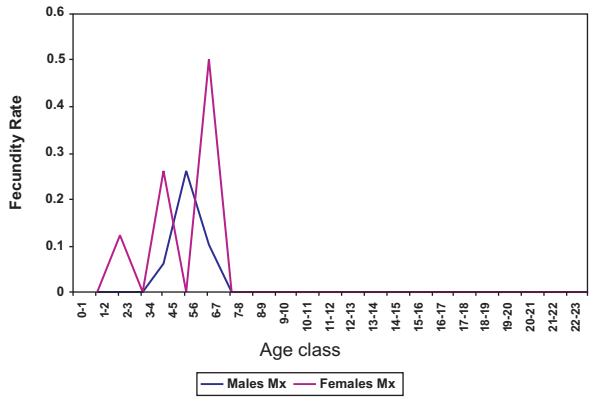

Fig. 9.4 : Comparision of Male/Female fecundity rates

Genetic Summary

The genetic summary of the captive population is presented in table 9.3. The table suggests that the genetic diversity of the population could have been much higher than the existing level.

Table 9.3 : Genetic Summary

	Current	Potential
Founders	7	10 additional
Founder genome equivalents	3.6	15.76
Founder genome surviving	5	15.76
Gene diversity retained	0.861	0.968
Population mean kinship	0.139	0.032
Mean inbreeding	0.05	0.032
Ne / N	0.13	-----
% of pedigree known	91	-----

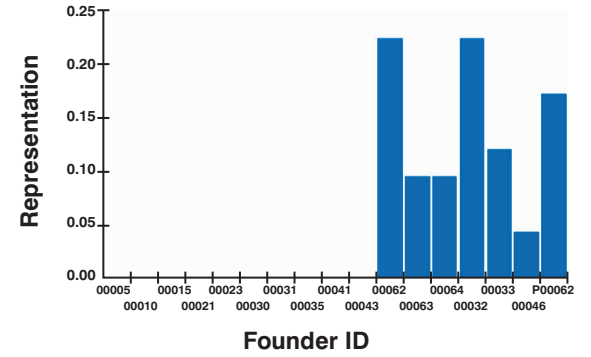

Fig 9.5 : Founder statistics of the captive Indian wild ass

The results of founder analysis are presented fig. 9.5, it suggests that a large number of the founder animals that entered the population exited without contributing their genes to the population. Moreover the animals that contributed their genes did so unequally. An equitable contribution of genes to the population would have a significant impact on the genetic diversity of the population.

Population Planning and Breeding Recommendations

Population modeling of the Captive Indian Wild Ass population was carried out using PM 2000. Based on the analysis it is envisaged that a population of 176 individuals is to be achieved over a span of the next 20 years. The management strategy for the species is summarized in table 9.4 and fig. 9.6. The maintenance of the desired level of genetic diversity (90% of the founder gene diversity) can be done by the addition of one founder animal for the next 50 years with a maximum population size of 200 individuals.

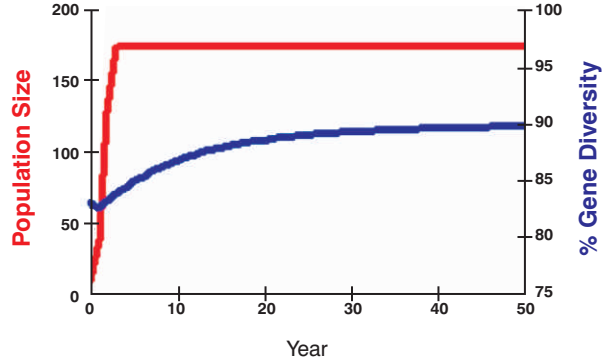

Fig 9.6 : Management Strategy for Indian Wild Ass in Captivity

Table 9.4 : Management Strategy

	Planned
Generation length	5.3
Population growth rate	3
Ne / N ratio	0.13
Initial gene diversity	0.887
Target population size	176
Maximum Allowable Population Size	200.0000
New Founders per Addition Event	1.0000
Year to Start Adding Founders	1.0000
Year to Stop Adding Founders	50.0000
Years Between Addition Events	1.0000
FGE Recruited per New Founder	0.4000

Possible pairings of living individuals were carried out based list of live animals ordered according to mean kinships (Table 9.5). Individuals at Sakkarbaug Zoo, Junagadh only, were selected for this purpose. The individuals at other locations were excluded out from the analysis because they are single animals and the possibility of finding mates for them is low. Transfer of animals from Sakkarbaug zoo is at present not recommended as it is the lone breeding population.

Table 9.5 : Ordered mean kinships

Males					Females				
Stbk#	**MK**	**Known**	**Age**	**Location**	**Stbk#**	**MK**	**Known**	**Age**	**Location**
00051	0.1125	100.0	21	Junagadh	00063	0.0500	100.0	0	Junagadh
00061	0.1375	50.0	14	Junagadh	00064	0.0500	100.0	0	Junagadh
00066	0.1438	100.0	5	Junagadh	00062	0.1125	100.0	0	Junagadh
00067	0.1438	100.0	4	Junagadh	00070	0.1438	100.0	3	Junagadh
00069	0.1438	100.0	4	Junagadh	00068	0.1750	100.0	4	Junagadh
00065	0.1875	100.0	8	Junagadh					

Based on the results obtained from the pairing options of PM 2000, the individuals in table 9.6 are recommended for mating based on the offspring's' inbreeding coefficients obtained from pairings.

Table 9.8 : Pairings recommended for breeding

Sl.No.	Sire	Dam	Inbreeding coefficient
1.	00061	00062	0
2.	00061	00063	0
3.	00061	00064	0
4.	00061	00068	0
5.	00061	00070	0
6.	00065	00063	0
7.	00065	00064	0
8.	00066	00064	0
9.	00067	00063	0
10.	00069	00064	0

GREY PEACOCK PHEASANT

BIOLOGY AND STATUS

Taxonomy

Kingdom	:	Animalia
Phylum	:	Chordata
Class	:	Aves
Order	:	Galliformes
Family	:	Phasianidae
Scientific Name	:	*Polyplectron bicalcaratum*
Species Authority	:	Linnaeus 1758
Common Name/s	:	Munowwar, Deyodahuk, Deoderik (Assam); Deodurrug (Garo), Dao dip, Dao dai dip, Mejoor (Cachar); Burruminrui (Nagaland); Katmōr (Chitagong).

Morphometry

Wing length	:	(♂)21.0-24.0 cm; (♀)17.5-21.5 cm
Tail length	:	(♂)35.0-24.0 cm; (♀)23.0-25.5 cm
Weight	:	(♂)568 - 910 g; (♀)460-500 g

Distribution

In India, central and eastern Himalayas from Sikkim through Arunachal Pradesh and northeastern states of Assam, Meghalaya, Manipur, Mizoram, Nagaland and Tripura.

Habitat

Evergreen and deciduous forests with thick undergrowth in the plains and foothills, thick cover along banks of rivers and secondary growth or mixed bamboo and thick scrub.

Diet

Omnivorous diet that include grains, berries, seeds, wild figs, insects, grubs, snails and other small animals.

Sexual Maturity

1 year

Breeding Season

Between the months of March and June chiefly during April and May

Incubation period

21 days

Clutch size

2, exceptionally 3-4

Threats

Habitat loss mainly due to the practice of jhum cultivation, hunting for food, feather used in fly tye equipments, is also a gamebird.

Status

Species is reported to be fairly abundant although populations are reported to be declining. In the Indian Wildlife Protection Act (IWPA) it has been listed as Schedule I, though the IUCN red list of threatened species (2010) lists it as LC. CITES has listed it as an Appendix II species.

Results & discussion

The current population of the grey peacock pheasant (table 10.1) consists of 33 (11.16.6) individuals. A total of 54 individuals have been kept in captivity since 1994.

Table 10.1 : Status in captivity in Indian zoos

Zoo Name	Male	Female	Unsexed	Total
Kamala Nehru Zoological Park, Ahmedabad	0	0	2	2
Alipore Zoo, Kolkatta	8	13	1	22
Padamaja Naidu Himalayan Zoological Park, Darjeeling	2	3	3	8
Veermata Jijabhai Bhonsle Udyan, Mumbai	1	0	0	1
Total	**11**	**16**	**6**	**33**

Further demographic and genetic analysis of the data was not carried out as the data available from zoos has poor information on the pedigree records and dates of entry and exit of specimens.

ASIATIC LION

BIOLOGY AND STATUS

Taxonomy

Kingdom	:	Animalia
Phylum	:	Chordata
Class	:	Mammalia
Order	:	Carnivora
Family	:	Felidae
Scientific Name	:	*Panthera leo persica*
Infra-specific Authority	:	(Meyer, 1826)
Common Name/s	:	Asiatic Lion, Indian lion, Babbar Sher (Hindi) etc

Morphometry

Body weight	:	(♂) 160 - 190 kg
	:	(♀) 110 - 120 kg

Distribution

Gir forests of Gujarat in India

Habitat

Dry deciduous forest cover interspersed with, moist mixed riverine valley forest patches along the perennial rivers and tropical thorn forest, preferably inhabit the cooler mixed forest riverine patches

Diet

Variety of forms ranging from the large sized ungulates viz. *Rusa unicolor* and domestic and feral cattle to the medium sized *Axis axis*

Age at first reproduction

Free ranging	:	(♂) 5 - 8 years; (♀) 4 years
Captivity	:	(♂) 3-4 years; (♀) 2-3 years

Gestation period

116 days approximately

Litter size

Ranging from 1 - 5 cubs

Longevity

Approximately 16 years (♂)
Approximately 17 - 18 years (♀)

Group size & structure

Prides of 2 or more than 2 females and 1 or more adult males with cubs and juveniles. The prides are matrilineal.

Threats

Exists as a single subpopulation, is thus vulnerable to extinction from unpredictable events, such as an epidemic or a large forest fire; dispersing individuals face the threat of retaliatory killing by humans in response to predation on livestock.

Status

Recent census conducted in 2010 revealed the existence of 411 adult lions in the greater Gir landscape. Listed as Endangered D ver 3.1 in IUCN Red List, 2008, CITES Appendix I and Schedule I of the Wildlife Protection Act (1972) GOI.

Results & discussion

The ex-situ population is summarized in table 11.1, there are 154 (73.81) individuals in 16 Indian zoos. The recorded history of the species in captivity shows the presence of a total of 672 (291.328.53) individuals in captivity so far of which 70 animals were of wild origin.

Table 11.1 : Status in captivity

Zoo Name	Male	Female	Total
Kamla Nehru Zoological Garden, Ahmedabad	1	1	2
Bannerghatta National Park, Bangalore	2	2	4
National Zoological Park, New Delhi	2	4	6
Gir Safari Park, Sasan	1	4	5
Nehru Zoological Park, Hyderabad	18	14	32
Sakkarbaug Zoo, Junagadh	36	37	73
Kanpur Zoological Park, Kanpur	1	3	4
Lucknow Zoological Park, Lucknow	0	1	1
Arignar Anna Zoological Park, Chennai	2	2	4
Sri Chamarajendra Zoological Garden, Mysore	0	1	1
Rajkot Zoological Park, Rajkot	4	5	9
Lion and Tiger Safari, Shimoga	1	1	2
Lion Safari Vasona, Silvasa	1	1	2
Sri Venkateswara Zoological Park, Tirupati	1	0	1
Van-Vihar National Park, Bhopal	2	4	6
Veermata Jijabai Bhosle Udyan, Mumbai	1	1	2
Total	**73**	**81**	**154**

Census and Demography

The Asiatic lion population in Indian zoos dates back to 1958 when the first recorded animal; a female was brought into captivity at Junagadh zoo. The population trends of Asiatic Lion in Indian zoos over the years are summarized in fig. 11.1.

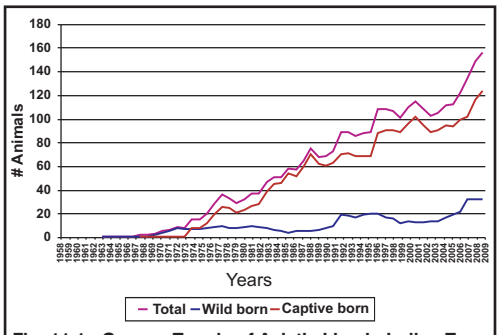

Fig. 11.1 : Census Trends of Asiatic Lion in Indian Zoos

The age structure (fig. 11.2) of living known age individuals of captive Asiatic lion population suggests the presence of maximum individuals of both sexes to be in the reproductive age classes. The age structure also suggests the absence of individuals in the neonatal and juvenile age classes. In order to ensure a stable population it is essential to replace as many animals that die each year in various age classes. It is appropriate to have large number of individuals in lower age classes to have a self sufficient population in zoos.

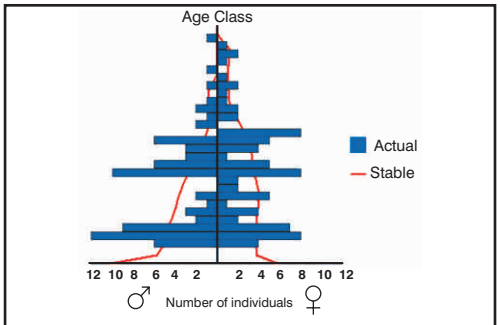

Fig. 11.2 : Age distribution of captive Asiatic lion

The life tables for males and females summarize the mortality and reproductive rates based on an analysis of mortality and reproductive rates. It can be used to estimate probabilities of an individual's survival and fecundity. The mortality rate (fig. 11.3) for both males and females shows a peak in the first year of life and thereafter shows a steady decline, peaking again in the 16th and 19th years respectively. Whereas the onset of fecundity for males is in the fourth year of life and a steady plateau is maintained till it declines and altogether ceases in the 15th - 16th year of life whereas for females initiation of reproductive activity is in the third year of life and a plateau is maintained till the 9th year of life, it then declines and altogether ceases by the 14th year of life (fig. 11.4).

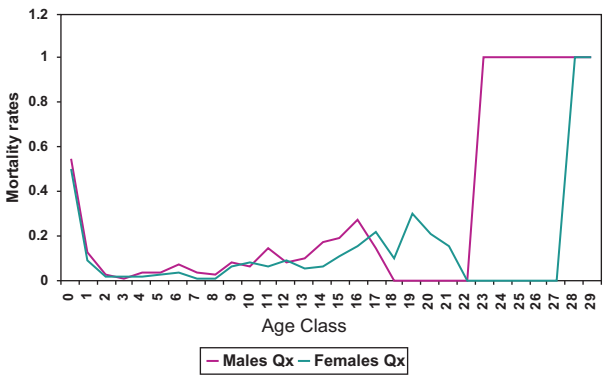

Fig. 11.3 : Comparision of Male/Female mortality rates

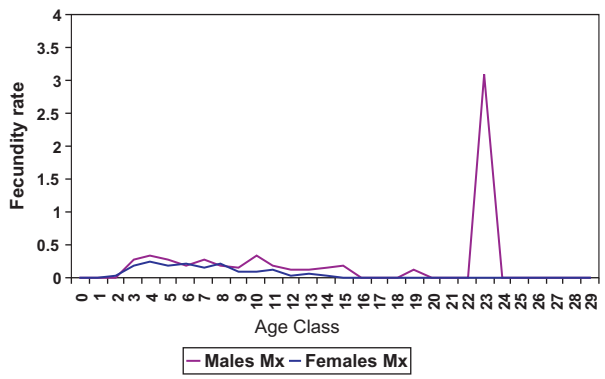

Fig. 11.4 : Comparision of Male/Female fecundity rates

The population growth rates (table 11.2) as determined by an analysis of the life table suggest an increasing trend for males and a declining trend for females. While the generation length for males is 9.25 years and that for females is 7.54 years.

Table 11.2 : Population growth rates

	Males	Females
Intrinsic rate of increase (r)	0.0146	-0.0325
lambda	1.0147	0.9680
Net Reproductive rate (R_0)	1.145	0.783
Generation lenght (T)	9.25	7.54

Table 11.3 : Genetic status of the captive population

Genetic variables	Current	Potential
Founders	36	24 additional
Founder genome equivalents	11.32	52.96
Founder genome surviving	27.93	52.96
Gene diversity retained	0.956	0.991
Population mean kinship	0.044	0.009
Mean inbreeding	0.046	0.009
Ne / N	0.28	-----
% of pedigree known	93	-----

Genetic Summary

The genetic summary of the captive Asiatic lion population is summarized in table 11.3. The captive population retains 95.6% of the in-situ genetic diversity through the various founders and has a low mean kinship.

An analysis of founder statistics reveals that studbook numbers 4, 5, 25, 65, 69, 261, 325 and 334 are overrepresented, while studbook numbers P471, P470, P 576, 7, 228, 229, 266, 267, 268, 322, 342, 400, 534, 542, 549, 560, 564 and 566 are underrepresented. The gene pool of animals with studbook numbers 428, 453, 515, 522, 526, 533, 551, 561, 563, 567, 574, 590, 593, 600, 624, 625, 626, 632, 633, 634, 635, 637 and 640 is not represented at all in the captive population. This overrepresentation of a few animals at the expense of the other animals suggests that a large proportion of the gene pool of the founder population remains to be expressed in the captive population; fig. 11.5 summarizes the founder representation in the captive population.

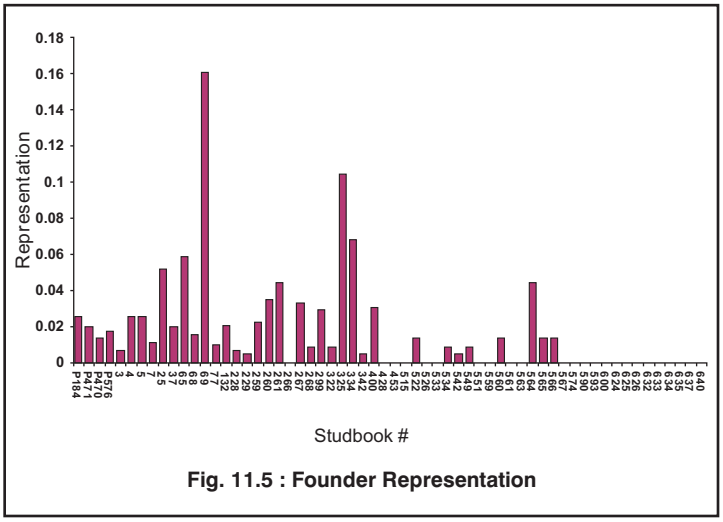

Fig. 11.5 : Founder Representation

Population Planning and Breeding Recommendations

Asiatic lion is a critically endangered subspecies of lion inhabiting the Gir landscape. A single free ranging population of less than 500 individuals makes it highly vulnerable to extinction. Earlier efforts at establishing an alternate population have failed. Fresh efforts at establishing a second population at Kuno have been initiated by the Government of India. For various reasons however; it has not been possible to translocate free ranging lions. In this context a genetically viable and demographically stable population capable of providing surpluses for reintroduction needs to be maintained to ensure the long term conservation of the species.

The captive population has retained a large portion of the original genetic diversity sampled from the free ranging population. With intensive efforts the captive Asiatic lion population in Indian zoos can be managed to retain more than 90% of the genetic diversity sampled and would maintain a demographically stable population capable of providing surpluses for reintroduction.

Population modeling of the captive Asiatic lion population using PM2000 suggests that a population size of 162 individuals from the current size of 154 individuals would ensure the maintenance of genetically viable and demographically stable population. The demographic and management strategy (table 11.4 and fig. 11.6) suggests that with a slightly negative growth rate of 0.991 and a generation length of 8. 4 years the target population size of 162 individuals can be achieved in the next 10 years. However the maintenance of the current rate of increase would also provide for surpluses for reintroduction.

Table 11.4 : Management Strategy

	Planned
Generation length	8.4
Population growth rate required	0.991
Ne / N ratio	0.28
Initial gene diversity	0.953
Target population size	155
# New founders needed	1
Year to Start Adding Founders	1
Year to Stop Adding Founders	21
Years Between Addition Events	1
FGE Recruited per New Founder	0.4000

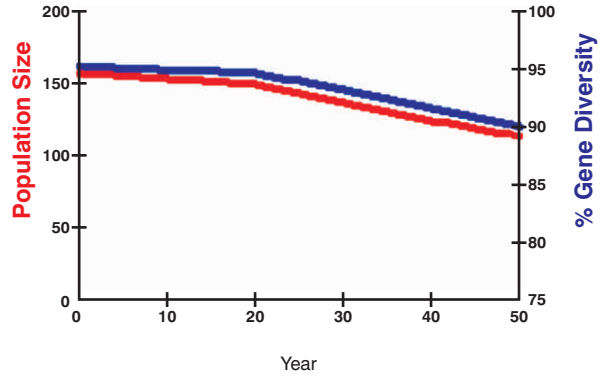

Fig. 11.6 : Demographic and genetic management strategy

Hypothetical pairings were carried out using the pairings option of PM 2000 from an ordered list in ascending order of mean kinships of living individuals (Table 11.5). The pairings options provides for inbreeding coefficients and mean kinship values of likely offspring. Individuals past their reproductive prime and those having high inbreeding coefficients and mean kinship values were excluded from the pairings exercise. Based on this hypothetical pairings between individuals that produced offspring with no or minimal inbreeding coefficients and very low mean kinships values were selected for breeding. The probable pairings that may be used in the conservation breeding program are accordingly summarized in table 11.6.

Table 11.5 : Ordered Mean Kinships

Males					Females				
Stbk#	**MK**	**Known**	**Age**	**Location**	**Stbk#**	**MK**	**Known**	**Age**	**Location**
428	0.0000	100.0	15	Junagadh	266	0.0000	100.0	0	Veermata
453	0.0000	100.0	12	Junagadh	526	0.0000	100.0	8	Junagadh
515	0.0000	100.0	14	Delhi	561	0.0000	100.0	15	Junagadh
533	0.0000	100.0	0	Junagadh	593	0.0000	100.0	6	Junagadh
551	0.0000	100.0	22	Vanvihar	626	0.0000	100.0	4	Junagadh
559	0.0000	100.0	15	Junagadh	634	0.0000	100.0	4	Junagadh
563	0.0000	100.0	13	Silvassa	637	0.0000	100.0	4	Junagadh
567	0.0000	100.0	12	Junagadh	640	0.0000	100.0	3	Junagadh
574	0.0000	100.0	8	Junagadh	367	0.0044	100.0	15	Junagadh
590	0.0000	100.0	6	Ahmedabad	522	0.0066	100.0	11	Junagadh
600	0.0000	100.0	5	Junagadh	591	0.0088	50.0	6	Junagadh
624	0.0000	100.0	4	Junagadh	609	0.0088	100.0	4	Junagadh
625	0.0000	100.0	4	Junagadh	662	0.0088	100.0	3	Junagadh
632	0.0000	100.0	4	Junagadh	320	0.0095	100.0	18	Junagadh
633	0.0000	100.0	4	Junagadh	52	0.0104	100.0	25	Trivandrum
635	0.0000	100.0	4	Junagadh	573	0.0126	100.0	9	Delhi
322	0.0044	100.0	0	Junagadh	299	0.0148	100.0	0	Hyderabad
534	0.0044	100.0	0	Junagadh	267	0.0165	100.0	0	Delhi
560	0.0066	100.0	15	Junagadh	480	0.0186	50.0	11	Kanpur
565	0.0066	100.0	13	Junagadh	482	0.0186	50.0	11	Kanpur
566	0.0066	100.0	12	Junagadh	659	0.0211	100.0	3	Junagadh
661	0.0088	100.0	3	Junagadh	537	0.0221	100.0	8	Gir Safari
53	0.0104	100.0	24	Trivandrum	538	0.0221	100.0	8	Gir Safari
596	0.0126	100.0	5	Delhi	486	0.0260	100.0	11	Delhi
400	0.0154	100.0	17	Junagadh	495	0.0284	100.0	10	Junagadh
628	0.0161	100.0	4	Junagadh	496	0.0284	100.0	10	Junagadh
481	0.0186	50.0	11	Hyderabad	576	0.0289	100.0	8	Junagadh
656	0.0211	100.0	3	Junagadh	622	0.0290	100.0	4	Junagadh
657	0.0211	100.0	3	Junagadh	623	0.0290	100.0	4	Junagadh
658	0.0211	100.0	3	Junagadh	647	0.0290	100.0	3	Junagadh
564	0.0219	100.0	13	Junagadh	348	0.0304	100.0	16	Ahmedabad
539	0.0221	100.0	8	Gir Safari	349	0.0304	100.0	16	Junagadh
577	0.0257	100.0	7	Junagadh	442	0.0317	100.0	12	Junagadh
586	0.0279	100.0	6	Junagadh	443	0.0317	100.0	12	Silvasa
587	0.0279	100.0	6	Junagadh	444	0.0317	100.0	12	Junagadh
645	0.0290	100.0	3	Junagadh	513	0.0317	100.0	9	Junagadh
646	0.0290	100.0	3	Junagadh	603	0.0317	100.0	5	Junagadh
449	0.0295	100.0	12	Junagadh	97	0.0320	100.0	26	Mysore
441	0.0317	100.0	12	Junagadh	470	0.0332	100.0	16	Gir Safar

Males					Females				
Stbk#	**MK**	**Known**	**Age**	**Location**	**Stbk#**	**MK**	**Known**	**Age**	**Location**
436	0.0370	100.0	12	Junagadh	471	0.0349	100.0	16	Gir Safar
118	0.0408	100.0	28	Madras	437	0.0370	100.0	12	Junagadh
297	0.0408	100.0	19	Junagadh	269	0.0378	100.0	21	Junagadh
355	0.0462	100.0	15	Hyderabad	289	0.0378	100.0	19	Junagadh
653	0.0467	100.0	3	Junagadh	333	0.0392	100.0	16	Delhi
654	0.0467	100.0	3	Rajkot	331	0.0393	100.0	16	Junagadh
671	0.0467	100.0	2	Junagadh	335	0.0396	100.0	16	Hyderabad
672	0.0467	100.0	2	Rajkot	410	0.0401	100.0	13	Junagadh
674	0.0467	100.0	2	Rajkot	140	0.0408	100.0	26	Vanvihar
675	0.0467	100.0	2	Junagadh	247	0.0408	100.0	22	Bannerghata
483	0.0501	100.0	11	Bannerghata	246	0.0419	100.0	22	Junagadh
431	0.0506	100.0	14	Bannerghata	332	0.0436	100.0	16	Junagadh
476	0.0512	100.0	11	Veermata	650	0.0467	100.0	3	Rajkot
478	0.0512	100.0	11	Hyderabad	651	0.0467	100.0	3	Junagadh
479	0.0512	100.0	11	Hyderabad	652	0.0467	100.0	3	Rajkot
568	0.0512	100.0	11	Hyderabad	676	0.0467	100.0	2	Junagadh
570	0.0520	00.0	11	Tirupati	377	0.0471	100.0	14	Junagadh
477	0.0548	100.0	11	Hyderabad	434	0.0496	100.0	12	Bannerghata
164	0.0639	100.0	20	Madras	578	0.0518	100.0	7	Hyderabad
350	0.0647	100.0	15	Madras	354	0.0525	100.0	15	Shimoga
617	0.0671	100.0	4	Hyderabad	569	0.0530	100.0	11	Hyderabad
619	0.0671	100.0	4	Hyderabad	572	0.0544	100.0	11	Hyderabad
620	0.0671	100.0	4	Hyderabad	130	0.0553	100.0	27	Vanvihar
655	0.0671	100.0	3	Hyderabad	284	0.0597	100.0	20	Junagadh
638	0.0709	100.0	3	Hyderabad	575	0.0618	100.0	8	Hyderabad
639	0.0709	100.0	3	Hyderabad	604	0.0623	100.0	5	Rajkot
670	0.0709	100.0	2	Hyderabad	352	0.0647	100.0	15	Madras
316	0.0726	100.0	18	Rajkot	353	0.0647	100.0	15	Madras
641	0.0727	100.0	3	Hyderabad	454	0.0654	100.0	11	Hyderabad
667	0.0727	100.0	2	Hyderabad	584	0.0671	100.0	6	Rajkot
455	0.0757	100.0	11	Hyderabad	585	0.0671	100.0	6	Rajkot
385	0.0824	100.0	14	Hyderabad	618	0.0671	100.0	4	Hyderabad
370	0.0835	100.0	15	Hyderabad	668	0.0709	100.0	2	Hyderabad
488	---	---	11	Kanpur	669	0.0709	100.0	2	Hyderabad
553	---	---	19	Vanvihar	666	0.0727	100.0	2	Hyderabad
555	---	---	17	Shimoga	124	0.0733	100.0	18	Lucknow
					382	0.0824	100.0	14	Hyderabad
					383	0.0824	100.0	14	Hyderabad
					384	0.0824	100.0	14	Kanpur
					489	---	---	11	Hyderabad

	550	---	---	23	Vanvihar
	552	---	---	19	Vanvihar
	643	---	---	3	Junagadh

Probable mating was carried out using the pairing option of PM 2000. The criteria used for determining pairings were that the probable offspring should have mean kinship values less than 0.01. The mating choices available for each living female of breeding age in the captive population are listed in table 11.6. While carrying out mate selection care must be exercised to avoid mating between more than one of a pair of siblings.

Table 11.6 : Mating recommendations for the captive Asiatic lion population in Indian zoos

Studbook No.	Age	Location	Can be paired with
434	12	Bannerghata	322, 355, 400, 428, 436, 441, 449, 453, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 586, 587, 590, 596, 600, 624, 625, 628, 632, 633, 635, 645, 646, 657, 658, 661
267	0	Delhi	322, 350, 355, 370, 385, 400, 428, 431, 436, 441, 449, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 574, 577, 586, 587, 590, 600, 617, 619, 620, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675
486	11	Delhi	322, 350, 370, 385, 400, 428, 431, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 624, 625, 628, 632, 633, 635, 641, 645, 646, 653, 654, 655, 656, 657, 658, 661, 667, 671, 672, 674, 675
573	9	Delhi	322, 350, 355, 370, 385, 400, 428, 431, 436, 441, 449, 453, 455, 476, 477, 478, 479, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 574, 577, 586, 587, 590, 600, 617, 619, 620, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675
537	8	Gir Safari	322, 350, 355, 400, 428, 436, 441, 449, 453, 455, 476, 477, 478, 479, 481, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 617, 619, 620, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675
538	8	Gir Safari	322, 350, 355, 370, 385, 400, 428, 431, 436, 441, 449, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 586, 587, 590, 596, 600, 617, 619, 620, 624, 625, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 661, 667, 670, 671, 672, 674, 675
299	0	Hyderabad	322, 350, 355, 370, 385, 400, 428, 431, 436, 441, 449, 453, 455, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 617, 619, 620, 624, 625, 628, 632, 633, 635, 641, 645, 646, 653, 654, 655, 656, 657, 658, 661, 667, 671, 672, 674, 675
382	14	Hyderabad	322, 355, 400, 428, 436, 441, 449, 453, 481, 488, 515, 533, 534, 555, 559, 560, 563, 564, 565, 566, 567, 574, 590, 596, 600, 624, 625, 628, 632, 633, 635, 656, 657, 658, 661
383	14	Hyderabad	322, 355, 400, 428, 436, 441, 449, 453, 481, 488, 515, 533, 534, 555, 559, 560, 563, 564, 565, 566, 567, 574, 590, 596, 600, 624, 625, 628, 632, 633, 635, 656, 657, 658, 661
454	11	Hyderabad	322, 355, 400, 428, 436, 441, 449, 453, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 574, 577, 586, 587, 590, 596, 600, 617, 619, 620, 624, 625, 628, 632, 633, 635 653, 654, 656, 657, 658, 661, 671, 672, 674, 675

Studbook No.	Age	Location	Can be paired with
489	11	Hyderabad	322, 350, 355, 370, 385, 400, 428, 431, 436, 441, 449, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 617, 619, 620, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675
569	11	Hyderabad	322, 355, 400, 428, 436, 441, 449, 453, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 574, 577, 586, 587, 590, 600, 624, 625, 628, 632, 633, 635, 645, 646, 653, 654, 656, 657, 658, 661, 671, 672, 674, 675
572	11	Hyderabad	322, 350, 355, 370, 385, 400, 428, 431, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 624, 625, 628, 632, 633, 635, 641, 645, 646, 656, 657, 658, 661, 667
575	8	Hyderabad	322, 400, 428, 453, 481, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 574, 577, 586, 587, 590, 596, 600, 624, 625, 628, 632, 633, 635, 645, 646, 656, 657, 658, 661
578	7	Hyderabad	322, 400, 428, 453, 455, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 574, 577, 586, 587, 590, 596, 600, 624, 625, 628, 632, 633, 635, 645, 646, 656, 657, 658, 661
618	4	Hyderabad	322, 400, 428, 453, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 574, 577, 590, 596, 600, 624, 625, 628, 632, 633, 635, 656, 657, 658, 661
666	2	Hyderabad	322, 355, 400, 428, 436, 441, 449, 453, 481, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 574, 577, 586, 587, 590, 596, 600, 624, 625, 628, 632, 633, 635, 653, 654, 656, 657, 658, 661, 671, 672, 674, 675
668	2	Hyderabad	322, 400, 428, 441, 449, 453, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 574, 577, 590, 596, 600, 624, 625, 628, 632, 633, 635, 656, 657, 658, 661
669	2	Hyderabad	322, 400, 428, 441, 449, 453, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 574, 577, 590, 596, 600, 624, 625, 628, 632, 633, 635, 656, 657, 658, 661
367	15	Junagadh	322, 350, 355, 370, 385, 400, 428, 431, 436, 441, 449, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 617, 619, 620, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675
377	14	Junagadh	322, 355, 400, 428, 436, 441, 449, 453, 481, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 574, 577, 590, 596, 600, 624, 625, 628, 632, 633, 635, 653, 654, 656, 657, 658, 661, 671, 672, 674, 675
410	13	Junagadh	322, 355, 400, 428, 436, 441, 449, 453, 476, 477, 478, 479, 481, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 590, 596, 600, 624, 625, 628, 632, 633, 635, 656, 657, 658, 661
437	12	Junagadh	322, 350, 355, 370, 385, 400, 428, 431, 436, 441, 449, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 617, 619, 620, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675
442	12	Junagadh	322, 350, 370, 385, 400, 428, 431, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675

Studbook No.	Age	Location	Can be paired with
444	12	Junagadh	322, 350, 370, 385, 428, 431, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675
495	10	Junagadh	350, 370, 385, 400, 428, 431, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 624, 625, 628, 632, 633, 635, 641, 645, 646, 656, 657, 658, 661, 667
496	10	Junagadh	350, 370, 385, 400, 428, 431, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 624, 625, 628, 632, 633, 635, 641, 645, 646, 656, 657, 658, 661, 667
513	9	Junagadh	322, 350, 370, 385, 428, 431, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675
522	11	Junagadh	322, 350, 355, 370, 385, 400, 428, 431, 436, 441, 449, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 617, 619, 620, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 656, 657, 658, 667, 670, 671, 672, 674, 675
526	8	Junagadh	322, 350, 355, 370, 385, 400, 428, 431, 436, 441, 449, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 617, 619, 620, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675
561	15	Junagadh	322, 350, 355, 370, 385, 400, 428, 431, 436, 441, 449, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 617, 619, 620, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675
576	8	Junagadh	322, 350, 355, 400, 428, 436, 441, 449, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 586, 587, 590, 596, 600, 617, 619, 620, 624, 625, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 661, 667, 670, 671, 672, 674, 675
591	6	Junagadh	322, 350, 355, 370, 385, 400, 428, 431, 436, 441, 449, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 617, 619, 620, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675
593	6	Junagadh	322, 350, 355, 370, 385, 400, 428, 431, 436, 441, 449, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 617, 619, 620, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675
603	5	Junagadh	322, 350, 370, 385, 428, 431, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675
609	4	Junagadh	322, 350, 355, 370, 385, 400, 428, 431, 436, 441, 449, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 617, 619, 620, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675

Studbook No.	Age	Location	Can be paired with
622	4	Junagadh	322, 355, 400, 428, 431, 436, 441, 449, 453, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 590, 596, 600, 624, 625, 628, 632, 633, 635, 653, 654, 655, 656, 657, 658, 661, 671, 672, 674, 675
623	4	Junagadh	322, 355, 400, 428, 431, 436, 441, 449, 453, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 590, 596, 600, 624, 625, 628, 632, 633, 635, 653, 654, 655, 656, 657, 658, 661, 671, 672, 674, 675
626	4	Junagadh	322, 350, 355, 370, 385, 400, 428, 431, 436, 441, 449, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 617, 619, 620, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675
634	4	Junagadh	322, 350, 355, 370, 385, 400, 428, 431, 436, 441, 449, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 617, 619, 620, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675
637	4	Junagadh	322, 350, 355, 370, 385, 400, 428, 431, 436, 441, 449, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 617, 619, 620, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675
640	3	Junagadh	322, 350, 355, 370, 385, 400, 428, 431, 436, 441, 449, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 617, 619, 620, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675
643	3	Junagadh	322, 350, 355, 370, 385, 400, 428, 431, 436, 441, 449, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 617, 619, 620, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675
647	3	Junagadh	322, 355, 400, 428, 431, 436, 441, 449, 453, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 567, 568, 570, 574, 577, 590, 596, 600, 624, 625, 628, 632, 633, 635, 653, 654, 655, 656, 657, 658, 661, 671, 672, 674, 675
651	3	Junagadh	322, 400, 428, 441, 449, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 624, 625, 628, 632, 633, 635, 641, 645, 646, 656, 657, 658, 661, 667
659	3	Junagadh	322, 350, 355, 370, 385, 400, 428, 431, 436, 441, 449, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 586, 587, 590, 596, 600, 617, 619, 620, 624, 625, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 661, 667, 670, 671, 672, 674, 675
662	3	Junagadh	322, 350, 355, 370, 385, 400, 428, 431, 436, 441, 449, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 617, 619, 620, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675
676	2	Junagadh	322, 400, 428, 441, 449, 453, 455, 476, 477, 478, 479, 481, 488, 515, 533, 534, 539, 555, 559, 560, 563, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 624, 625, 628, 632, 633, 635, 641, 645, 646, 656, 657, 658, 661, 667

Studbook No.	Age	Location	Can be paired with
384	14	Kanpur	322, 355, 400, 428, 436, 441, 449, 453, 481, 488, 515, 533, 534, 555, 559, 560, 563, 564, 565, 566, 567, 574, 590, 596, 600, 624, 625, 628, 632, 633, 635, 656, 657, 658, 661
480	11	Kanpur	322, 350, 355, 370, 385, 400, 428, 431, 436, 441, 449, 453, 455, 476, 477, 478, 479, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 574, 577, 586, 587, 590, 596, 600, 617, 619, 620, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675
482	11	Kanpur	322, 350, 355, 370, 385, 400, 428, 431, 436, 441, 449, 453, 455, 476, 477, 478, 479, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 574, 577, 586, 587, 590, 600, 617, 619, 620, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675
352	15	Madras	322, 355, 400, 428, 436, 441, 449, 453, 481, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 574, 577, 590, 596, 600, 624, 625, 628, 632, 633, 635, 656, 657, 658, 661
353	15	Madras	322, 355, 400, 428, 436, 441, 449, 453, 481, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 574, 577, 590, 596, 600, 624, 625, 628, 632, 633, 635, 656, 657, 658, 661
584	6	Rajkot	322, 400, 428, 453, 481, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 574, 577, 586, 587, 590, 596, 600, 624, 625, 628, 632, 633, 635, 645, 646, 656, 657, 658, 661
585	6	Rajkot	322, 400, 428, 453, 481, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 574, 577, 586, 587, 590, 596, 600, 624, 625, 628, 632, 633, 635, 645, 646, 656, 657, 658, 661
604	5	Rajkot	322, 400, 428, 453, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 624, 625, 628, 632, 633, 635, 645, 646, 656, 657, 658, 661
650	3	Rajkot	322, 400, 428, 441, 449, 453, 455, 476, 477, 478, 479, 481, 488, 515, 533, 534, 539, 555, 559, 560, 563, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 624, 625, 628, 632, 633, 635, 641, 645, 646, 656, 657, 658, 661, 667
652	3	Rajkot	322, 400, 428, 441, 449, 453, 455, 476, 477, 478, 479, 481, 488, 515, 533, 534, 539, 555, 559, 560, 563, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 624, 625, 628, 632, 633, 635, 641, 645, 646, 656, 657, 658, 661, 667
354	15	Shimoga	322, 350, 355, 400, 428, 436, 441, 449, 453, 455, 481, 483, 488, 515, 533, 534, 555, 559, 560, 563, 564, 565, 566, 567, 574, 590, 596, 600, 624, 625, 628, 632, 633, 635, 656, 657, 658, 661
443	12	Silvasa	322, 350, 370, 385, 428, 431, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675
266	0	Veermata	322, 350, 355, 370, 385, 400, 428, 431, 436, 441, 449, 453, 455, 476, 477, 478, 479, 481, 483, 488, 515, 533, 534, 539, 555, 559, 560, 563, 564, 565, 566, 567, 568, 570, 574, 577, 586, 587, 590, 596, 600, 617, 619, 620, 624, 625, 628, 632, 633, 635, 638, 639, 641, 645, 646, 653, 654, 655, 656, 657, 658, 661, 667, 670, 671, 672, 674, 675

NILGIRI LANGUR

BIOLOGY AND STATUS

Taxonomy

Kingdom	:	Animalia
Phylum	:	Chordata
Class	:	Mammalia
Order	:	Primates
Family	:	Cercopithecidae
Scientific Name	:	*Trachypithecus johnii*
Species Authority	:	J. Fischer, 1829
Common Name/s	:	Manthi (Tamil), Karing korangu (Malyalam), Turuni Kodan, Pershk (Toda), Kurri Korunga (Badaga & Kurumba), John's leaf monkey, Black leaf monkey, Hooded leaf monkey

Morphometry

Head and body length:		(♂) 78 - 80 cm (♀) 58 - 60 cm
Tail length	:	68.5 - 96.5 cm
Weight	:	(♂) 9.1 - 14.8 kg (♀) 10.9-12 kg

Distribution

Endemic to the southern portion of the Western Ghats in south India. Its range states include Kerala, Karnataka and Western Tamil Nadu.

Habitat

Characteristically inhabit the sholas or evergreen forest, may also venture into semi-evergreen, moist deciduous forests, montane temperate evergreen forests, riverine forest and even teak plantations.

Diet

Primarily folivorous, but also feed upon fruits, nuts, flowers, buds, seeds, bark, stems, insects, and earth.

Gestation Period

200 days

Birth Season

Peak season is May-June and subsidiary season is from September - November

Litter Size

1

Troop structure & size

Occur mostly as unimale groups, sometimes multi- male; quite often all -male groups are observed though all-female groups occur as well but are rare, also rarely individual may live solitary. The group size has been varyingly reported to range between 2 to 29.

Home range

2.2 to 6.4 ha / group

Threats

Habitat destruction, loss and fragmentation (for timber production, teak plantation and fuel wood and other NTFP collection) and poaching for pelt, flesh, blood, organs to produce medicines and aphrodisiacs.

Status

Listed under Appendix II of CITES, Schedule I, Part I of Indian Wildlife Protection Act, 1972 and Vulnerable C2a (i) under IUCN Red data list.

Results & discussion

The current population of Nilgiri Langur comprises of 30 individuals (table 12.1) housed in four Indian Zoos. Historically 37 (15.19.3) individuals have been kept in captivity since 1986.

Table 12.1 : Status in captivity

Zoo Name	Males	Females	Unknown	Total
Nehru Zoological Park, Hyderabad	3	1		4
Thiruvananthapuram (trivandrum) Zoo,	1	1		2
Srignar Anna Zoological Park, Chennai	6	11	2	19
Sri Chamarajendra Zoological Garden, Mysore	1	4		5
Total	**11**	**17**	**2**	**30**

Further demographic and genetic analysis of the data was not carried out as the data available has poor information on the pedigree records and dates of entry and exit of specimens. Moreover the population size is limited in captivity.

LION TAILED MACAQUE

BIOLOGY AND STATUS

Taxonomy		
Kingdom	:	Animalia
Phylum	:	Chordata
Class	:	Mammalia
Order	:	Primates
Family	:	Cercopithecidae
Scientific Name	:	*Macaca silenus*
Species Authority	:	Linnaeus, 1758
Common Name/s	:	*Siah Bandar* (Hindi), *Neel Bandar* (Bengali), *Singalika* (Kannada), *Karingode* (Coorgi), *Neela manthi, Chingala* (Malyalam), *Kuram, Karangu, Arakkan* (Tamil), *Kondamachu* (Telugu)
Morphometry		
Head and body length	:	(♂) 51.0-61.0cm; (♀) 46.0cm
Tail length	:	(♂) 25.4-38.6cm; (♀) 25.4-32.0cm
Weight	:	(♂) 5-10kg; (♀) 3-6kg

Distribution

Endemic to Western Ghats, roughly distributed from 8?25'N Kalakkadu Hills to 14?55'N north of Anshi Ghat (Grooves, 2001). Restricted to three south Indian states of Karnataka, Kerala and Tamil Nadu.

Habitat

Tropical rain forest of Western Ghats, occupies dense evergreen hilly forest of high trees, inhabiting an altitude between 610-1070 m. Also known to occupy cardamom and tea plantation when interspersed with undisturbed evergreen forest

Diet

Primarily frugivorous but as it also feeds upon selected fauna; is classified as frugivorous/faunivorous. The carbohydrate and protein rich diet chiefly consist of fruits and seeds (57.5%), faunal group (37.3%) and other plant parts (5%).

Age at first reproduction	80 months(In wild); 48 months (In captivity)
Mating Season	Peak during January and February
Gestation Period	162-186 days
Weaning	10 month(%); 7 months($)
Troop structure & size	The species has a multi male - multi female group structure with sub adult and juveniles. The troop size of free ranging groups varies with location, which appears to be dependent upon resource availability in general, undisturbed habitats are known to hold groups of 7 to 40 animals

Threats

Habitat fragmentation, deterioration, conversion and hunting are the main threats faced by the species. The animal is poached for its meat by many tribal communities, as it is supposed to possess medicinal properties.

Status

Recent estimates suggest of a population size of 3550 individuals existing as fragmented population all over the western ghats. It has been listed as Endangered C2a(i) ver 3.1 in IUCN Red Data List, Appendix I of CITES and Schedule I of Wildlife Protection Act, 1972.

Results & Discussion

In India there are 86(44.41.1) individuals housed across 20 Institutions. Details of the living population are presented in table13.1.

Table 13.1 : Status in captivity

Zoo Name	Males	Females	Unknown	Total
Assam State Zoo cum Botanical Garden	0	1	0	1
National Zoological Park, New Delhi	3	1	1	5
Sri Chamarajendra Zoo (Mysore Zoo), Mysore	7	6	0	13
Arignar Anna Zool Park Chennai, Chennai,	9	11	0	20
Nehru Zoological Park, Hyderabad,	0	2	0	2
Nandankanan Biological Park, Orissa	0	1	0	1
Kanpur Zoological Park, Uttar Pradesh	2	2	0	4
Mahendra Chaudhary Zoological Park,	1	0	0	1
Bannerghatta Zool Garden National Park,	1	0	0	1
Thiruvananthapuram (Trivandrum) Zoo,	9	6	0	15
Parassinikkadavu Snake Park, Kerala	1	2	0	3
Maitri Bagh Zoo, Bhilai, Chhattisgarh	2	3	0	5
Sanjay Gandhi Biol.Park, Bihar	1	3	0	4
Children's Corner, Guindy Chennai	2	0	0	2
Alipore Zoological Garden, Calcutta	1	1	0	2
Jaipur Zoological Garden, Rajasthan	1	0	0	1
Trichur Zoo	1	0	0	1
Kodanadu Mini Zoo, Kerala	1	0	0	1
Lady Hydari Park and Animal Land, Shillong	1	2	0	3
Lucknow Zoological Park, Lucknow	1	0	0	1
Total	**44**	**41**	**1**	**86**

The records of lion tailed macaque being in captivity dates back to 1966, across the time the number of individuals is 256 (113.121.22).

Census and Demography

A study of census graph (fig. 13.1) reveals that the population has been growing since 1971, even though there were periods of slight depression (1976, 1985, 1989, 1991-1999) the wider picture projects a steadily growing population, that has grown from mere 20 individuals in 1971 to 86 in 2010.

Age pyramid of Lion tailed macaque (Fig. 13.2) suggests that there is a low number of breeding individuals (between the ages of 9-20) in the population most of the animals are either past breeding age or are in sub-adult stage. The age pyramid reflects that for certain age classes one of the sexes is nearly absent i.e the population is highly skewed towards one of the sex in that age class. Also there is a gap at the base of the pyramid which though not very prominent indicates the absence of neonates in the population. There is thus an urgent need to increase the reproductive rate of the captive population and sex representation need to be balanced for all age classes.

Life table for lion tailed macaque reveals that the male population is growing at a rate of 0.026 with a generation length of 11.56 years, while female population is declining at a rate of -0.0381 with a generation length of 10.84 years. Other demographic characteristics as obtained from life tables, like percent of population change per year (Lambda) and rate of change per generation (Net Reproductive rate, R_0) have been summarized in Table 13.2.

Age specific mortality rate (Qx) (fig. 13.3) for female population is higher than males for younger age classes. The Qx is high for males in 23-24 and 26-27 age classes. The comparison also reveals that males are at higher risk in 31-32 and 32-33 age classes than females which are at higher risk in later age classes. Age specific fertility rate or fecundity (Mx) suggest that the breeding in

LTM onsets when in 2-3 age class, and they breed up to 22-23 years. Mx is higher for males almost across all the age classes but for younger classes of 2-3, 3-4 and mature classes of 19-20, 20-21 and 21-22, implying that in the breeding classes more males are reproducing as compared to females in the same age classes (fig. 13.4). Thus there are probabilities that though females would live longer but males would produce more number of offspring in the population.

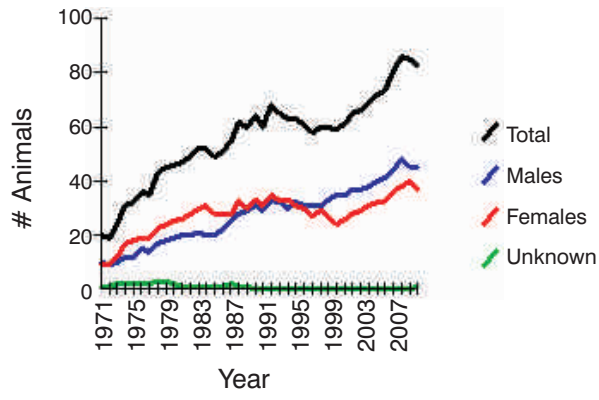

Figure 13.1 : Census trends of captive Lion tailed macaque

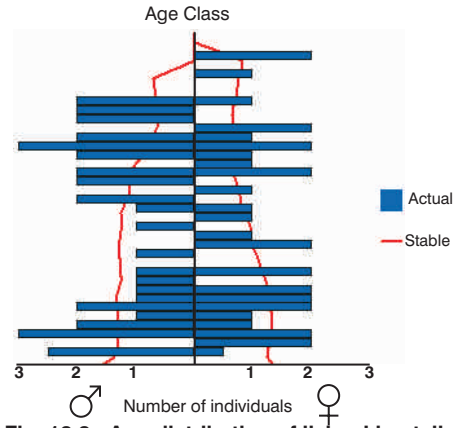

Fig. 13.2 : Age distribution of living Lion tailed

Table 13.2 : Population growth rates

Population Parameters	Males	Females
Intrinsic rate of increase (r)	0.0258	-0.0381
Lambda	0.9745	0.9626
Net Reproductive rate (R_0)	0.742	0.662
Generation length (T)	11.56	10.84

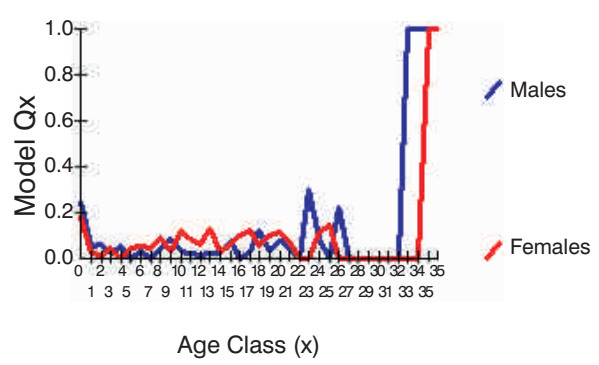

Figure 13.3 : Comparison of mate-female mortality

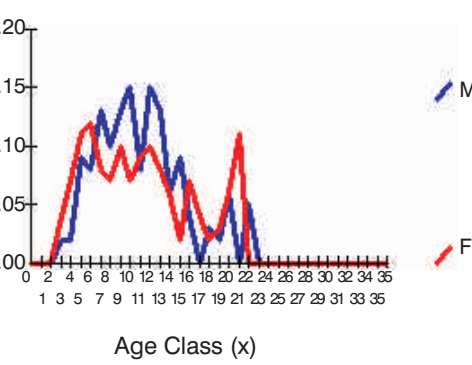

Figure 13.4 : Comparison of mate-female fecundity

Genetic Summary

Results of genetic analysis show that 89% genetic diversity is being retained by the Lion tailed macaque population. The gene value was calculated to be 0.82, which is relatively moderate. Although current population size is 88, mean 'effective' population size is only 13.82 over the past 2.56 generations. The current Ne though is better at 16.94 estimated from 8 males and 9 female breeders. Such low effective population size depicts that population is neither effectively maintaining genetic diversity across the generations nor breeding randomly. Mean effective size can be augmented by equalizing the sex ratio, decreasing the variability in family size, checking the fluctuations in the population size over generations and avoiding overlap of generations. The population genetics have been summarized in Table 13.3.

Table 13.3 : Genetic status of the captive Lion tailed macaque population

Genetic variables	Current	Potential
Founders	22	36 additional
Founder genome equivalents	4.52	48.46
Founder genome surviving	12.17	48.46
Gene diversity retained	0.889	0.99
Population mean kinship	0.111	0.01
Mean inbreeding	0.166	0.01
Ne / N	0.2	-----
% of pedigree known	91	-----

The founder statistics show that there are 22 founders with living descendants in the population, the potential founder number is as high as 36. However, the Founder Genome Equivalents (fge) and Founder Genome Surviving are low because though the population has a lot of wild origin individuals, considerable number of founders (36) are not contributing to the population at all. Some are being overrepresented (WILDM2, WILDM1, 132, WILD2, WILD1, WILD3) while some are underrepresented (WILD4, WILD3, WILD2, WILD1, 104, 154) (fig. 13.5). Thus, there is a need to equalize the founder representation hence the under-represented founder should be given more breeding opportunities. It should be noted that increasing breeding of under-represented founder's descendants may increase loss of heterozygosity.

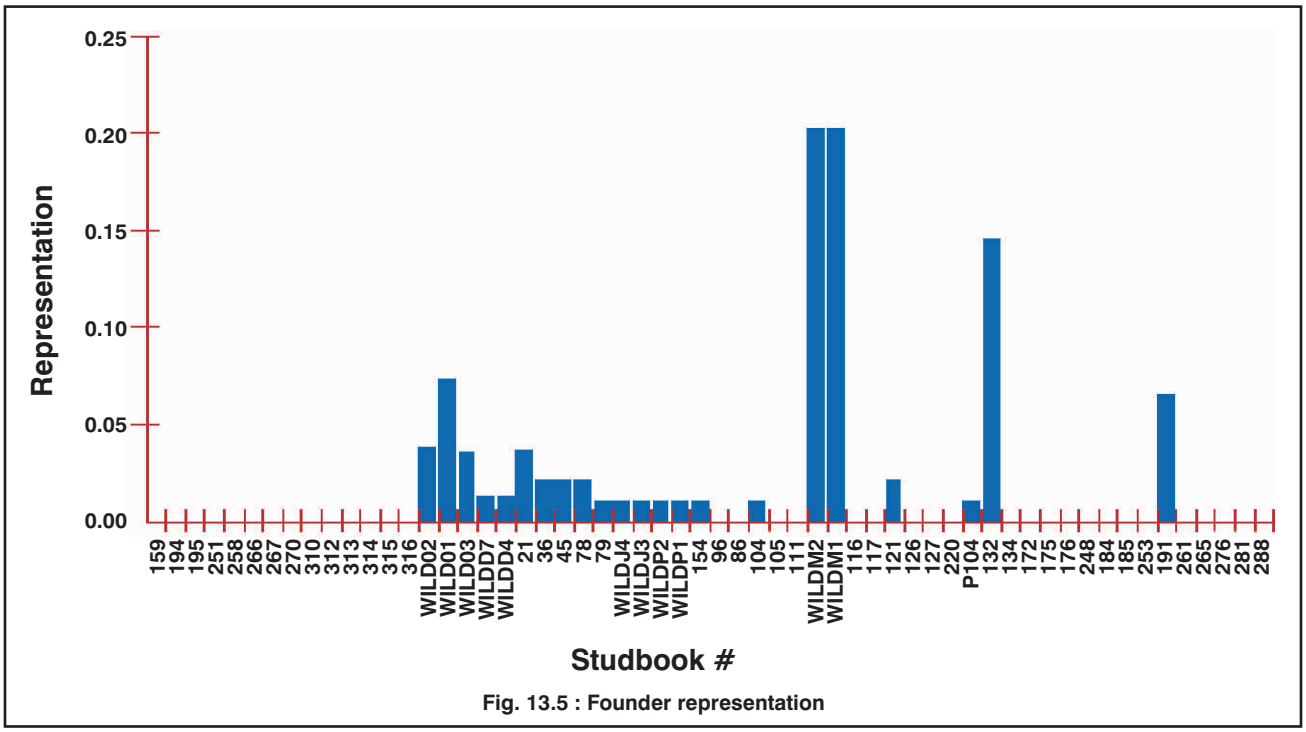

Fig. 13.5 : Founder representation

Population Planning and Breeding Recommendations

Population modeling of captive lion tailed macaque housed in Indian zoos using pm2000 software; suggest that for achieving the population genetic management goals if the present demographic and genetic trends remain unaltered, a very large number of founders would be required. Such target is difficult to achieve in the present situation, since lion tailed macaque wild population itself is in a precarious situation and it shall be difficult to procure such large number of founder for captive breeding program. Hence, a feasible genetic management goal of maintaining 90% genetic diversity for 50 years is suggested; for which a population of 150 individuals needs to be maintained with the addition of one founder every alternate year for the next 45 years (fig. 13.6). This scenario would require the minimal number of founders to be included in the captive breeding program. This goal though can be achieved even with a lesser number of founders and lesser individuals if the genetic and demographic structure of

the population is improved by breeding all founders equally and all individuals randomly and applying such practices in future that conserves maximum genetic diversity (Table 13.4).

Mean kinship (MK) (Table 13.5) is a measure of relatedness of an individual with other living animals (descendants & captive bred), with '0' indicating no relatedness to any individual in the population and '1' indicating relatedness to all the individuals. Therefore, the probable pairing options within lion tailed macaque population for breeding were selected on the basis of least mean kinship values (Table 13.6).

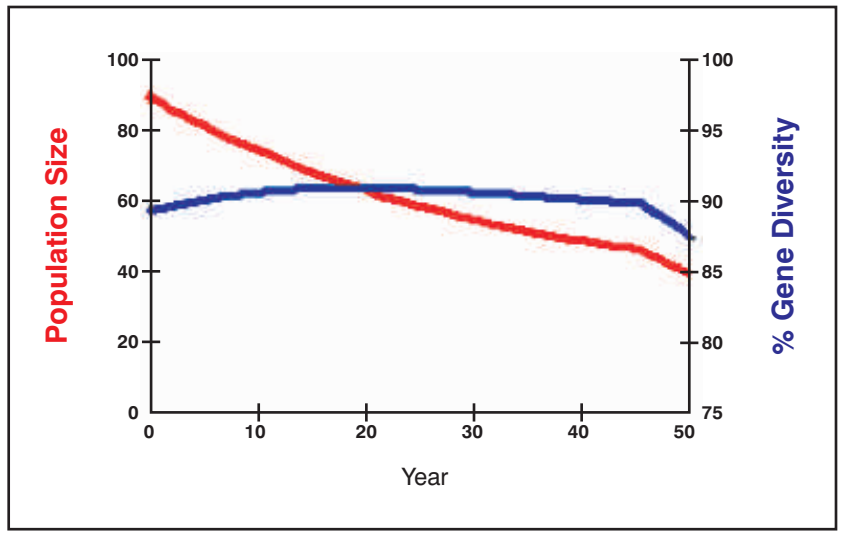

Table 13.4 : Management strategy

Population Variables	Planned
Generation length	11.2
Population growth rate	0.969
Ne / N ratio	0.2
Initial gene diversity	0.889
Target population size	150
# New founders needed	1

Table 13.5 : Ordered mean kinships of captive Lion tailed macaques

Males					Females				
Stbk#	**MK**	**Known**	**Age**	**Location**	**Stbk#**	**MK**	**Known**	**Age**	**Location**
96	0.0000	100.0	29	Trivandrum	86	0.0000	100.0	29	Mysore
105	0.0000	100.0	28	Kodanadu	116	0.0000	100.0	26	Trivandrum
111	0.0000	100.0	27	Parassinikkadavu	117	0.0000	100.0	26	Hyderabad
126	0.0000	100.0	24	Trivandrum	127	0.0000	100.0	24	Trivandrum
134	0.0000	100.0	23	Trivandrum	172	0.0000	100.0	21	Trivandrum
159	0.0000	100.0	0	Mysore	175	0.0000	100.0	21	Mysore
176	0.0000	100.0	21	Mysore	184	0.0000	100.0	19	Mysore
194	0.0000	100.0	0	Calcutta	185	0.0000	100.0	17	Parassinikkadavu
220	0.0000	100.0	24	Trichur	195	0.0000	100.0	0	Calcutta
248	0.0000	100.0	20	Mysore	251	0.0000	100.0	0	Patna
265	0.0000	100.0	9	Mysore	253	0.0000	100.0	14	Mysore
266	0.0000	100.0	0	Trivandrum	258	0.0000	100.0	0	Parassinikkadavu
267	0.0000	100.0	0	Trivandrum	261	0.0000	100.0	10	Mysore
270	0.0000	100.0	0	Trivandrum	281	0.0000	100.0	6	Mysore
276	0.0000	100.0	7	Mysore	310	0.0000	100.0	0	Patna
288	0.0000	100.0	5	Mysore	312	0.0000	100.0	0	Trivandrum

Males					Females				
Stbk#	**MK**	**Known**	**Age**	**Location**	**Stbk#**	**MK**	**Known**	**Age**	**Location**
313	0.0000	100.0	0	Trivandrum	314	0.0000	100.0	0	Shillong
316	0.0000	100.0	0	Shillong	315	0.0000	100.0	0	Shillong
123	0.0137	100.0	25	Chatbir Z	121	0.0110	100.0	25	Trivandrum
124	0.0165	100.0	25	Kanpur	135	0.0110	100.0	24	Assam
200	0.0179	100.0	12	Jaipur	211	0.0110	100.0	34	Kanpur
98	0.0585	100.0	29	Kanpur	136	0.0158	100.0	23	Hyderabad
177	0.0648	100.0	20	Patna	66	0.0165	100.0	32	Kanpur
138	0.0729	100.0	23	Delhi	191	0.0330	100.0	13	Madras
280	0.0790	100.0	6	Trivandrum	57	0.0677	100.0	34	Nandankanan
221	0.0817	100.0	24	Bhilai	291	0.0790	100.0	5	Trivandrum
219	0.0862	100.0	28	Bhilai	167	0.0862	100.0	22	Bhilai
284	0.1058	100.0	6	Madras	262	0.0898	100.0	10	Bhilai
308	0.1058	100.0	1	Madras	275	0.0898	100.0	7	Bhilai
186	0.1360	100.0	17	Trivandrum	294	0.1058	100.0	4	Madras
307	0.1449	100.0	1	Madras	304	0.1058	100.0	3	Madras
298	0.1520	100.0	4	Madras	273	0.1113	100.0	8	Madras
303	0.1521	50.0	3	Delhi	300	0.1449	100.0	3	Madras
170	0.1569	100.0	21	Hyderabad	272	0.1473	100.0	8	Delhi
183	0.1569	100.0	18	Guindy	305	0.1520	100.0	2	Madras
189	0.1569	100.0	15	Mysore	306	0.1520	100.0	2	Madras
292	0.1659	100.0	4	Madras	190	0.1597	100.0	13	Madras
302	0.1659	100.0	3	Madras	187	0.1679	100.0	16	Madras
110	0.1662	100.0	27	Madras	279	0.1684	100.0	6	Madras
182	0.1676	100.0	18	Guindy	277	0.1726	100.0	7	Madras
263	0.1726	100.0	10	Delhi	311	---	---	0	Patna
271	0.1726	100.0	8	Madras					
301	0.1726	100.0	3	Madras					
83	---	---	0	Bannerghata					
317	---	---	0	Lucknow					

Ordered Mean Kinships for Unknown sex animals

Stbk#	**MK**	**Known**	**Age**	**Location**
309	0.1148	100.0	1	DELHI

Table 13.6 : Pairing option for the captive Lion tailed macaque population

S. No.	Studbook #	Age	Suggested Pair
1.	83	Unk	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 262, 272, 273, 275, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315
2	110	~27	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 187, 191, 195, 211, 251, 253, 258, 261, 262, 272, 275, 281, 310, 311, 312, 314, 315
3.	111	~27	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 262, 272, 273, 275, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315
4.	116	~26	83, 159, 219, 110, 111, 123, 124, 221, 126, 220, 134, 138, 176, 170, 194, 248, 177, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 280, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308
5.	117	~26	83, 159, 219, 110, 111, 123, 124, 221, 126, 220, 134, 138, 176, 170, 194, 248, 177, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 280, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308
6.	121	~25	83, 159, 219, 110, 111, 123, 124, 221, 126, 220, 134, 138, 176, 170, 194, 248, 177, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308
7.	123	25	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 262, 272, 273, 275, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315
8.	124	25	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 262, 272, 273, 275, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315
9.	126	~24	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 262, 272, 273, 275, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315
10.	127	~24	83, 159, 219, 110, 111, 123, 124, 221, 126, 220, 134, 138, 176, 170, 194, 248, 177, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 280, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308
11.	134	~23	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 262, 272, 273, 275, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315
12.	135	23	83, 159, 219, 110, 111, 123, 124, 221, 126, 220, 134, 138, 176, 170, 194, 248, 177, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 280, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308
13.	136	23	83, 159, 219, 110, 111, 123, 124, 221, 126, 220, 134, 138, 176, 170, 194, 248, 177, 182, 183, 186, 189, 316, 317, 263, 265, 266, 267, 270, 271, 276, 280, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308
14.	138	23	116, 117, 121, 127, 135, 136, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 272, 273, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315
15.	159	Unk	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 262, 272, 273, 275, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315
16.	167	21	83, 159, 110, 111, 123, 124, 126, 220, 134, 176, 170, 194, 248, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 280, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308

S. No.	Studbook #	Age	Suggested Pair
17.	172	~21	83, 159, 219, 110, 111, 123, 124, 221, 126, 220, 134, 138, 176, 170, 194, 248, 177, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 280, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308
18.	175	~21	83, 159, 219, 110, 111, 123, 124, 221, 126, 220, 134, 138, 176, 170, 194, 248, 177, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 280, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308
19.	176	~21	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 262, 272, 273, 275, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315
20.	177	19	116, 117, 121, 127, 135, 136, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 272, 273, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315
21.	182	18	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 191, 195, 211, 251, 253, 258, 261, 262, 275, 281, 310, 311, 312, 314, 315
22.	183	18	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 191, 195, 211, 251, 253, 258, 261, 262, 275, 281, 310, 311, 312, 314, 315
23.	184	19	83, 159, 219, 110, 111, 123, 124, 221, 126, 220, 134, 138, 176, 170, 194, 248, 177, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 280, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308
24.	185	17	83, 159, 219, 110, 111, 123, 124, 221, 126, 220, 134, 138, 176, 170, 194, 248, 177, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 280, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308
25.	186	16	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 191, 195, 211, 251, 253, 258, 261, 262, 275, 281, 310, 311, 312, 314, 315
26.	187	16	83, 159, 219, 111, 123, 124, 221, 126, 220, 134, 138, 176, 194, 248, 177, 316, 200, 317, 265, 266, 267, 270, 276, 313, 288
27.	189	15	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 191, 195, 211, 251, 253, 258, 261, 262, 275, 281, 310, 311, 312, 314, 315
28.	190	13	83, 159, 219, 111, 123, 124, 221, 126, 220, 134, 138, 176, 194, 248, 177, 316, 200, 317, 265, 266, 267, 270, 276, 313, 288
29.	191	~13	83, 159, 219, 110, 111, 123, 124, 221, 126, 220, 134, 138, 176, 170, 194, 248, 177, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 280, 313, 288, 292, 298, 301, 302, 303
30.	194	Unk	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 262, 272, 273, 275, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315
31.	195	Unk.	83, 159, 219, 110, 111, 123, 124, 221, 126, 220, 134, 138, 176, 170, 194, 248, 177, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 280, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308
32.	200	12	116, 117, 121, 127, 135, 167, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 262, 272, 273, 275, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315
33.	211	~34	83, 159, 219, 110, 111, 123, 124, 221, 126, 220, 134, 138, 176, 170, 194, 248, 177, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 280, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308
34.	219	28	116, 117, 121, 127, 135, 136, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 272, 273, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315

S. No.	Studbook #	Age	Suggested Pair
35.	220	~24	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 262, 272, 273, 275, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315
36.	221	24	116, 117, 121, 127, 135, 136, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 272, 273, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315
37.	248	20	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 262, 272, 273, 275, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315
38.	251	Unk	83, 159, 219, 110, 111, 123, 124, 221, 126, 220, 134, 138, 176, 170, 194, 248, 177, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 280, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308
39.	253	14	83, 159, 219, 110, 111, 123, 124, 221, 126, 220, 134, 138, 176, 170, 194, 248, 177, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 280, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308
40.	258	Unk	83, 159, 219, 110, 111, 123, 124, 221, 126, 220, 134, 138, 176, 170, 194, 248, 177, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 280, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308
41.	261	~10	83, 159, 219, 110, 111, 123, 124, 221, 126, 220, 134, 138, 176, 170, 194, 248, 177, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 280, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308
42.	262	10	83, 159, 110, 111, 123, 124, 126, 220, 134, 176, 170, 194, 248, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 280, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308
43.	263	9	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 191, 195, 211, 251, 253, 258, 261, 262, 275, 281, 310, 311, 312, 314, 315
44.	265	~9	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 262, 272, 273, 275, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315
45.	266	Unk	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 262, 272, 273, 275, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315
46.	267	Unk	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 262, 272, 273, 275, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315
47.	270	Unk.	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 262, 272, 273, 275, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315
48.	271	8	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 191, 195, 211, 251, 253, 258, 261, 262, 275, 281, 310, 311, 312, 314, 315
49.	272	8	83, 159, 219, 110, 111, 123, 124, 221, 126, 220, 134, 138, 176, 194, 248, 177, 316, 200, 317, 265, 266, 267, 270, 276, 313, 288
50.	273	7	83, 159, 219, 111, 123, 124, 221, 126, 220, 134, 138, 176, 194, 248, 177, 316, 200, 317, 265, 266, 267, 270, 276, 313, 288
51.	275	7	83, 159, 110, 111, 123, 124, 126, 220, 134, 176, 170, 194, 248, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 280, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308
52.	276	~7	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 262, 272, 273, 275, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315

S. No.	Studbook #	Age	Suggested Pair
53.	277	7	83, 159, 219, 111, 123, 124, 221, 126, 220, 134, 138, 176, 194, 248, 177, 316, 200, 317, 265, 266, 267, 270, 276, 313, 288
54.	279	6	83, 159, 219, 111, 123, 124, 221, 126, 220, 134, 138, 176, 194, 248, 177, 316, 200, 317, 265, 266, 267, 270, 276, 313, 288
55.	280	6	116, 117, 127, 135, 136, 167, 172, 175, 184, 185, 191, 195, 211, 251, 253, 258, 261, 262, 275, 281, 310, 311, 312, 314, 315
56.	281	~6	83, 159, 219, 110, 111, 123, 124, 221, 126, 220, 134, 138, 176, 170, 194, 248, 177, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 280, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308
57.	284	6	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 195, 211, 251, 253, 258, 261, 262, 275, 281, 310, 311, 312, 314, 315
58.	288	~5	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 262, 272, 273, 275, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315
59.	291	4	83, 159, 219, 111, 123, 124, 221, 126, 220, 134, 138, 176, 194, 248, 177, 316, 200, 317, 265, 266, 267, 270, 276, 313, 288
60.	292	4	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 191, 195, 211, 251, 253, 258, 261, 262, 275, 281, 310, 311, 312, 314, 315
61.	294	4	83, 159, 219, 111, 123, 124, 221, 126, 220, 134, 138, 176, 194, 248, 177, 316, 200, 317, 265, 266, 267, 270, 276, 313, 288
62.	298	4	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 191, 195, 211, 251, 253, 258, 261, 262, 275, 281, 310, 311, 312, 314, 315
63.	300	3	83, 159, 219, 111, 123, 124, 221, 126, 220, 134, 138, 176, 194, 248, 177, 316, 200, 317, 265, 266, 267, 270, 276, 313, 288
64.	301	3	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 191, 195, 211, 251, 253, 258, 261, 262, 275, 281, 310, 311, 312, 314, 315
65.	302	3	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 191, 195, 211, 251, 253, 258, 261, 262, 275, 281, 310, 311, 312, 314, 315
66.	303	3	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 191, 195, 211, 251, 253, 258, 261, 262, 275, 281, 310, 311, 312, 314, 315
67.	304	2	83, 159, 219, 111, 123, 124, 221, 126, 220, 134, 138, 176, 194, 248, 177, 316, 200, 317, 265, 266, 267, 270, 276, 313, 288
68.	305	2	83, 159, 219, 111, 123, 124, 221, 126, 220, 134, 138, 176, 194, 248, 177, 316, 200, 317, 265, 266, 267, 270, 276, 313, 288
69.	306	2	83, 159, 219, 111, 123, 124, 221, 126, 220, 134, 138, 176, 194, 248, 177, 316, 200, 317, 265, 266, 267, 270, 276, 313, 288
70.	307	1	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 195, 211, 251, 253, 258, 261, 262, 275, 281, 310, 311, 312, 314, 315
71.	308	1	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 195, 211, 251, 253, 258, 261, 262, 275, 281, 310, 311, 312, 314, 315
72.	310	Unk	83, 159, 219, 110, 111, 123, 124, 221, 126, 220, 134, 138, 176, 170, 194, 248, 177, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 280, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308
73.	311	Unk	83, 159, 219, 110, 111, 123, 124, 221, 126, 220, 134, 138, 176, 170, 194, 248, 177, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 280, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308

S. No.	Studbook #	Age	Suggested Pair
74.	312	Unk	83, 159, 219, 110, 111, 123, 124, 221, 126, 220, 134, 138, 176, 170, 194, 248, 177, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 280, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308
75.	313	Unk	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 262, 272, 273, 275, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315
76.	314	Unk	83, 159, 219, 110, 111, 123, 124, 221, 126, 220, 134, 138, 176, 170, 194, 248, 177, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 280, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308
77.	315	Unk	83, 159, 219, 110, 111, 123, 124, 221, 126, 220, 134, 138, 176, 170, 194, 248, 177, 182, 183, 186, 189, 316, 200, 317, 263, 265, 266, 267, 270, 271, 276, 280, 284, 313, 288, 292, 298, 301, 302, 303, 307, 308
78.	316	Unk	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 262, 272, 273, 275, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315
79.	317	Unk	116, 117, 121, 127, 135, 136, 167, 172, 175, 184, 185, 187, 190, 191, 195, 211, 251, 253, 258, 261, 262, 272, 273, 275, 277, 279, 281, 291, 294, 300, 304, 305, 306, 310, 311, 312, 314, 315

It is to be noted that no pairing has been suggested for some live animal viz. studbook no. 57, 66, 86, 96, 98 and 105. They have been kept out, since our life table data suggests that the animals breed up to the age of 22 years, taking a margin of five years an upper limit of 27 years was decided and thus no breeding recommendation was given for the older animals.

ROYAL BENGAL TIGER

BIOLOGY AND STATUS

Taxonomy	Kingdom	:	Animalia
	Phylum	:	Chordata
	Class	:	Mammalia
	Order	:	Carnivore
	Family	:	Felidae
	Scientific Name	:	*Panthera tigris tigris*
	Species Authority	:	Linnaeus, 1758
	Common Name/s	:	Bengal tiger (English), Bagh, Sher (Hindi), Bagh (Nepali), Wagh (Marathi), Poolee (Tamil & Telugu)
Morphometry	Body length	:	(♂)270-310 cm; (♀) 240-265 cm
	Weight	:	(♂)175-260 kg; (♀) 100-160 kg
Distribution	The sub-species exist in India, Nepal, Bhutan and Bangladesh. In India they range from Lesser Himalayas, Gangetic Plains, Central India, Eastern Ghat, Western Ghat, North-eastern hills, Brahmaputra Plains and Sunderbans.		
Habitat	Occur in thorny, tropical dry and moist deciduous forest, evergreen and semi-evergreen forest, and mixed sub-tropical forests on foothills of Himalayas. They are also found in riparian terai grasslands and swampy mangrove forests.		
Diet	An opportunistic predator, it has a diverse prey base that includes sambar *(Rusa unicolor)*, chital *(Axis axis)*, barasingha/swamp deer *(Rucervus duvaucelii)*, wild boar *(Sus scrofa)*, hog deer *(Axis porcinus)*, barking deer *(Muntiacus muntjak)*, nilgai/blue bull *(Boselaphus tragocamelus)*, chousingha *(Tetracerus quadricornis)*, chinkara *(Gazella bennettii)*, black buck *(Antilope cervicapra)*, gaur *(Bos gaurus)*, wild buffalo *(Bubalus bubalis)* serow *(Naemorhedus sumatraensis)*, porcupine *(Hystrix indica)*, Hanuman langur *(Semnopithecus entellus)*, rhesus macaque *(Macaca mulata)*, bonnet macaque *(Macaca radiata)*, peafowl *(Pavo cristatus)*. Apart from the wild prey, domestic cattle constitute a large part of their diet.		
Age at first reproduction	Free ranging	:	(♂)4.8 years (mean)
		:	(♀) 3.8 years (mean)
Gestation period	100 -112 days		
Litter size	Ranging from 1 - 7 cubs (mostly 2-4)		
Longevity	12-15 years (in wild); 20 years or more (in captivity)		
Threats	Poaching; retaliatory killing; prey base depletion and habitat loss, degradation and fragmentation.		
Status	The current wild population as concluded in 2010 tiger census report is 1706. Listed as endangered A2bcd+4bcd; C1+2a (i) under IUCN Red data list; Schedule I, Part I of Indian Wildlife Protection Act, 1972 and is placed under Appendix I of CITES		

Results & discussion

The ex-situ population comprises of a total of 78 (44.34.0) individuals of wild/known decent in 30 Indian zoos, as summarized in table 14.1. Across time 328 (146.168.14) specimens of wild/known lineage have been housed in captivity.

Table 14.1 : Status of Bengal tiger with known / wild lineage in Indian zoos

Zoo Name	Males	Females	Unknown	Total
Arignar Anna Zoological Park, Chennai	2	0	0	2
Assam State Zoo cum Botanical Garden, Guwahati	1	0	0	1
Aurangabad Municipal Zoo, Aurangabad	1	0	0	1
Bannerghatta Zool Garden National Park, Bangalore	1	0	0	1
Bharat Ratna Pandit Gobind Ballabh Pant, Nainital	1	1	0	2
Biological Park Itanagar	1	2	0	3
Borivilli National Park, Mumbai	0	2	0	2
Gandhi Zoological Park, Gwalior	1	1	0	2
Indira Gandhi Zoological Park, Visakapatnam	4	5	0	9
Jawaharlal Nehru Biological Park, Bokaro	1	0	0	1
Jodhpur Zoological Garden, Jodhpur	1	1	0	2
Kamala Nehru Prani Sanghrahalay Zoo, Indore	4	1	0	5
Kanan Pendari Zoo, Bilaspur	0	2	0	2
Kanpur Zoological Park	1	0	0	1
Lucknow Zoological Park	2	0	0	2
Maitri Bagh Zoo, Bhilai, Chhattisgarh	5	4	0	9
Mahendra Chaudhary Zoological Park, Chatbir	1	0	0	1
Maharaj Bag Zoological Garden, Nagpur	1	0	0	1
Nandankanan Biological Park, Bhubaneswar	0	1	0	1
National Zoological Park, New Delhi	2	1	0	3
Nehru Zoological Park, Hyderabad	2	2	0	4
Padmaja Naidu Himalayan Zool. Park, Darjeeling	1	1	0	2
Rohtak Zoo, Rohtak	1	0	0	1
Sakkarbaugh Zoo, Junagadh	1	0	0	1
Shivarama Karanth Pilikula Biological Park, Mangalore	2	2	0	4
Shree Sayaji Baug Zoo, Vadodara	1	0	0	1
Sri Chamarajendra Zoological Garden, Mysore	2	3	0	5
Tiger & Lion Safari, Thyavarekoppa, Shimoga	1	1	0	2
Van Vihar National Park, Bhopal	3	4	0	7
V.O.C. Park Mini Zoo, Coimbatore	0	1	0	1
Total	**44**	**34**	**0**	**78**

Scope of the Studbook

In the present edition of the studbook animals of known lineage and wild origin have been included in the analysis. All animals that have the white gene or are of unknown lineage have been excluded from analysis and have been placed separately. Detailed demographic and genetic analysis has been carried out for animals whose ancestry is known and are not known to carry the recessive gene for pseudo-albinism.

Census and Demography

The first animal a tigress of wild origin entered the captive population in 1951. In 1959 two tigers of wild origin entered the captive population. The first captive birth of a normal coloured tiger occurred in 1967. The current population includes 28 animals of wild origin and 50 born in captivity. Details of census are provided in fig. 14.1.

The age distribution pattern of known age individuals as shown in fig. 14.2 in the captive population shows an absence of individuals in the reproductive age classes. Whereas a large number of individuals present in the captive population are in the post reproductive age classes. This is suggestive of a declining population due to the presence of only a few individuals of known origin in the captive Bengal tiger population in Indian zoos. The same is reflected by the absence of individuals in the lower age classes. The few individuals present in the population above 25 years of age are outliers and have no contribution to make to the captive population. Their continued presence is an indicator of the improved health care and husbandry practices in the facilities holding these animals.

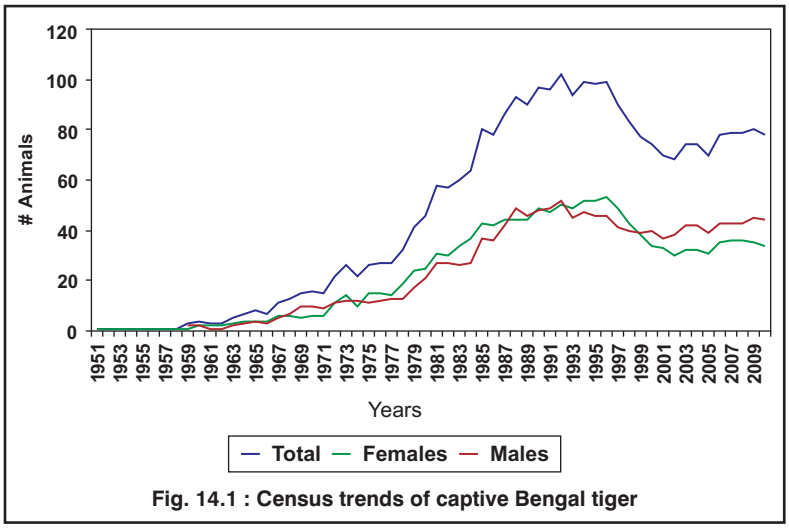

Fig. 14.1 : Census trends of captive Bengal tiger

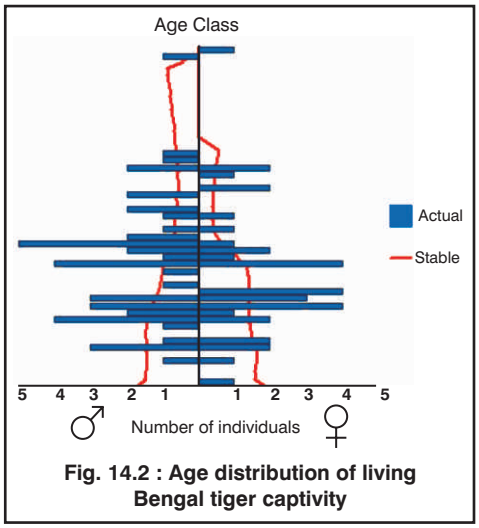

Fig. 14.2 : Age distribution of living Bengal tiger captivity

Life table results are presented as population growth rate table (table 14.2) and mortality and fecundity rate graphs (figs. 14.3 & 14.4). The mortality rates in the first year of life are extremely high (males 0.23 and females 0.27). Mortality rates for males thereafter are at a low rate till the 13th year when they rise sharply and then in 19th year of life when they peak again and remain high till the 20th year. However, for females peaks are observed in the 6th, 8th, 13th and 18th years of life. High rates of mortality are observed in females from the 20th to 24th year of life. A few animals of both sexes continue to survive after the last peaks in mortality are observed.

Reproductive activity for males and females start at 3 years of age in the captive population. Fecundity for males peaks in the 10th year of life while for females it is highest in the 6th year of life. For males reproductive activity ceases by the 17th year of life while for females additional peaks are observed 10th and 13th years. Reproductive activity is observed to cease by the 15th year of life.

Results of life table analysis suggest that neonatal to juveniles are the most vulnerable age classes for captive tigers. Changing the way pregnant and nursing tigresses are housed and the way they are managed may change the scenario. A study of population growth rates (Table 14.2) suggest that the captive Bengal tiger population of known origin in Indian zoos is declining. The rate of decline is faster for females than males. This decline can be controlled by breeding all available known origin tigers in the reproductive age classes by judicious pairing to ensure genetic viability and demographic stability. The generation length for males is marginally higher at 9.8 years.

Table 14.2 : Population growth rates

	Males	Females
Intrinsic rate of increase (r)	-0.0286	-0.0466
lambda	0.9718	0.9545
Net Reproductive rate (R_0)	0.756	0.644
Generation length (T)	9.80	9.44

Fig. 14.3 : Comparision of Male/Female mortality rates

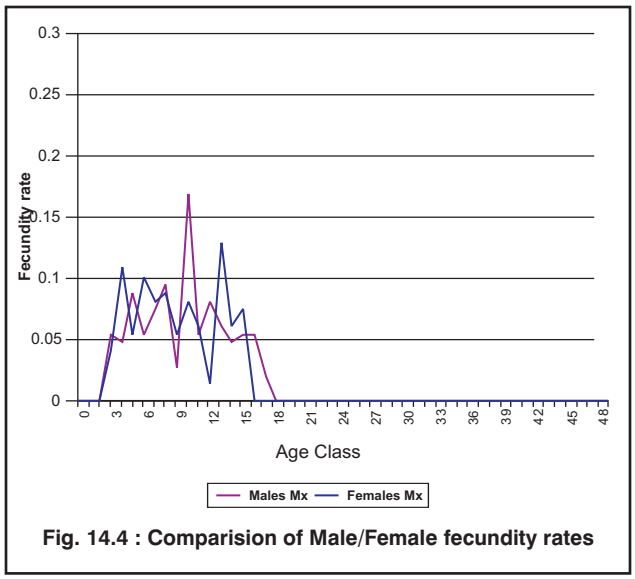

Fig. 14.4 : Comparision of Male/Female fecundity rates

Genetic Summary

Table 14.3 summarizes the genetic status of the captive Bengal tiger population. The captive population had a total of 48 founder animals out of which, only 23 contributed their genes to the captive population. The presence of a large number of founder animals in the captive population has resulted in it retaining a high level of genetic diversity. However, improperly planned mating choices have resulted in relatively high levels of relatedness between individuals as evinced by the values for mean kinship (0.076) and mean inbreeding (0.143).

The captive population had a total of 48 founder animals out of which only 23 were used for breeding purposes. Of these 23 animals stud # 00004, 00007, 00013, 00015, 00049 and 00075 are over represented; 16 other founder animals that contributed to the population are underrepresented while 25 animals are not represented at all. Several animals which are under represented have either reached reproductive senescence or are already dead Stud # 00290, 00298, 00301, 00307, 00308, 00309, 00311, 00316, 00317, 00318, 00321, 00322, 00323, 00324, 00325, 00326 and 00327; a total of additional founders can be used for breeding. Fig. 14.5 summarizes the founder representation in of the captive population.

Table 14.3 : Genetic status of the captive population

	Current	Potential
Founders	23	25 additional
Founder genome equivalents	6.55	41.01
Founder genome surviving	15.56	41.01
Gene diversity retained	0.924	0.988
Population mean kinship	0.076	0.012
Mean inbreeding	0.143	0.012
Ne / N	0.21	-----
% of pedigree known	100	-----

The captive population has a large number of inbred individuals in both the living and the dead individuals. There are 179 individuals overall with no inbreeding. However, a large proportion of them are dead. Inbreeding coefficients of 0.125 was present in 21 animals, 0.1875 in 15 animals, 0.2188 in 1 animal, 0.25 in 68 animals, 0.2813 for 5 animals, 0.2969 for 4 animals, 0.3125 for 3 animals and 0.375 for 5 animals. The high values of inbreeding coefficients and mean inbreeding coefficients are suggestive of the continued loss of genetic diversity of the population. This in turn impacts the overall fitness of the species due to increased disease susceptibility and lower reproductive rates.

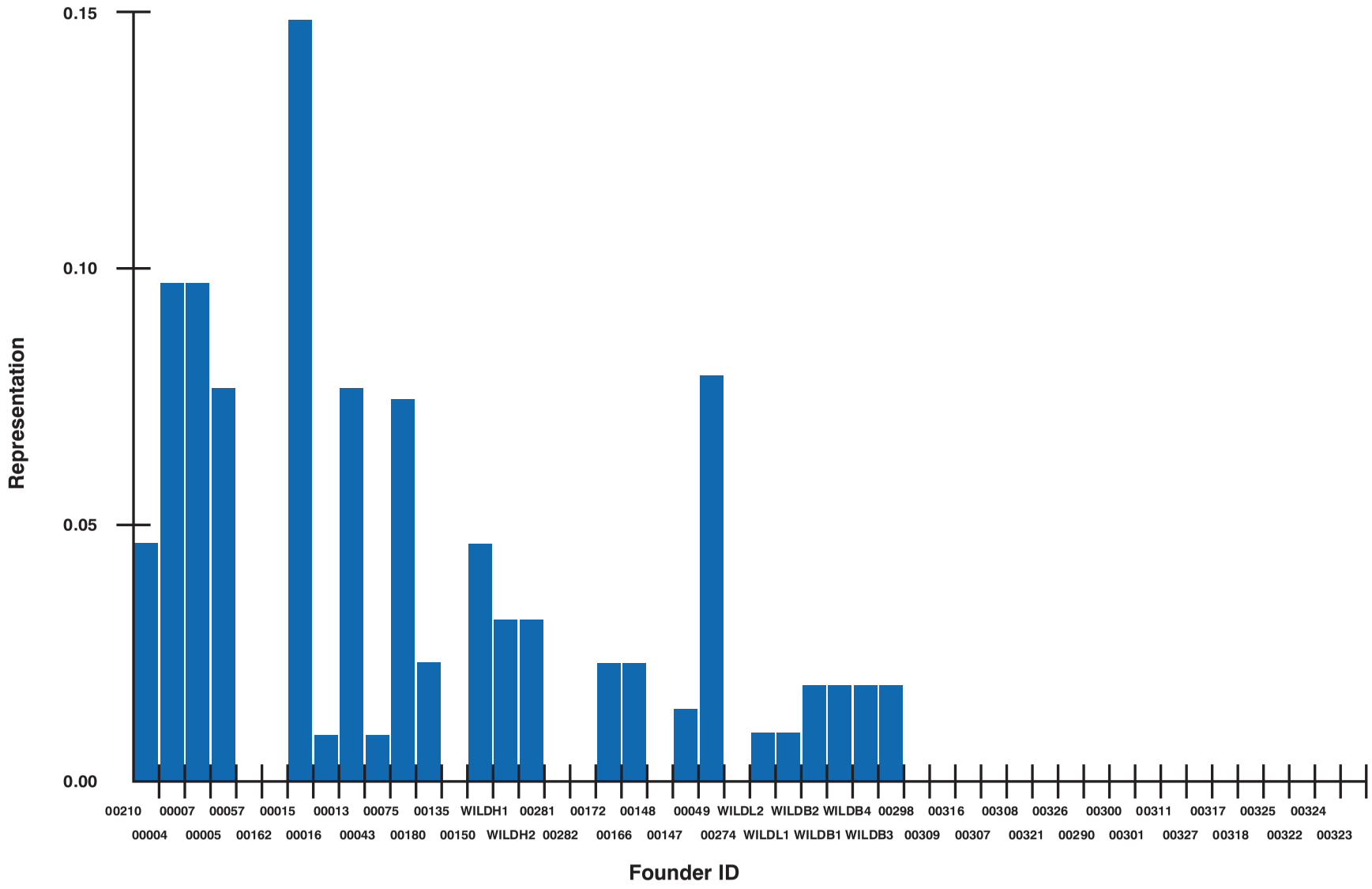

Fig. 14.5: Founder representation

Population Planning and Breeding Recommendations

The captive population requires intensive management efforts to ensure the long term survival of a genetically viable and demographically stable population for insurance purpose. For this purpose, the known origin captive population of Bengal tiger was modeled using the goals scenario of PM2000. This suggests the increase of the current population of 78 specimens to 179 specimens over the next 8 years, would ensure meeting the requirements of a demographically stable population. The management strategy table 14.4 and fig. 14.6 suggests that with a generation length of 9.6 years and a population growth rate of 1.1 would ensure meeting the objectives of a self sustaining captive population.

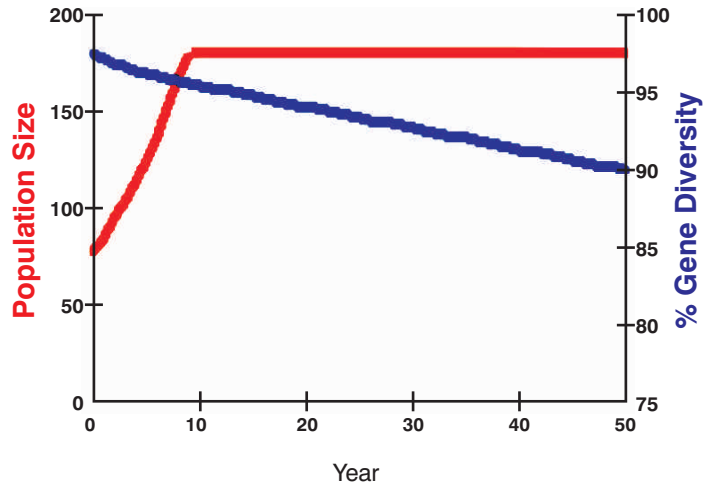

Fig. 14.6 : Demographic and genetic management strategy

Table 14.4 : Management Strategy

Population variables	Values
Generation Length	9.6000
Maximum Potential Population Growth Rate	1.1000
Current Population Size	78.0000
Population Size Needed to Meet Goals Needed	179
Current Effective Size	15.6000
Ratio of Ne/N	0.2000
Current Gene Diversity	0.9776
Maximum Allowable Population Size	200.0000
New founders needed	0
Program Objectives : 90% Gene Diversity at the end of 50 years	

Pairings were carried out using the pairings scenario of PM2000. This scenario generates an ordered list of mean kinships animals of both sexes (table 14.5). Animals with mean kinship values below 0.01 and a maximum age of 17 years (based on life table analysis) were used for pairings.

Table 14.5 : Ordered mean kinships

Males					Females				
Stbk#	**MK**	**Known**	**Age**	**Location**	**Stbk#**	**MK**	**Known**	**Age**	**Location**
00162	0.0000	100.0	47	Chatbir Z	00057	0.0000	100.0	48	Patna
00135	0.0000	100.0	31	Vanvihar	00282	0.0000	100.0	31	Gwalior
00281	0.0000	100.0	31	Gwalior	00309	0.0000	100.0	13	Darjeeling
00148	0.0000	100.0	25	Aurangabad	00316	0.0000	100.0	13	Vanvihar
00274	0.0000	100.0	20	Delhi	00307	0.0000	100.0	12	Delhi
00298	0.0000	100.0	14	Bannerghata	00326	0.0000	100.0	11	Mysore
00308	0.0000	100.0	11	Darjeeling	00290	0.0000	100.0	11	Borivilli
00321	0.0000	100.0	11	Mysore	00300	0.0000	100.0	9	Borivilli

Males					Females				
Stbk#	**MK**	**Known**	**Age**	**Location**	**Stbk#**	**MK**	**Known**	**Age**	**Location**
00301	0.0000	100.0	9	Vanvihar	00317	0.0000	100.0	6	Vanvihar
00311	0.0000	100.0	8	Assam	00318	0.0000	100.0	6	Nandankanan
00327	0.0000	100.0	6	Kanpur	00322	0.0000	100.0	5	Nainital
00325	0.0000	100.0	5	Lucknow	00323	0.0000	100.0	3	Mysore
00324	0.0000	100.0	3	Nainital	00081	0.0093	100.0	31	Chatbir Z
00251	0.0093	100.0	20	Lucknow	00172	0.0116	100.0	28	Itanagar
00166	0.0116	100.0	27	Hyderabad	00243	0.0140	100.0	18	Vanvihar
00183	0.0140	100.0	22	Itanagar	00265	0.0140	100.0	17	Bilaspur
00242	0.0140	100.0	18	Vanvihar	00266	0.0140	100.0	17	Bilaspur
00248	0.0163	100.0	17	Hyderabad	00277	0.0163	100.0	13	Itanagar
00231	0.0279	100.0	19	Delhi	00249	0.0186	100.0	17	Hyderabad
00232	0.0279	100.0	19	Indore	00210	0.0233	100.0	0	Indore
00255	0.0279	100.0	17	Indore	00283	0.0726	100.0	12	Hyderabad
00256	0.0279	100.0	17	Indore	00109	0.0797	100.0	28	Visakapatnam
00257	0.0279	100.0	17	Indore	00235	0.0797	100.0	19	Visakapatnam
00142	0.0802	100.0	25	Brahamcha	00214	0.0852	100.0	20	Mangalore
00065	0.0856	100.0	33	Rohtak	00156	0.0911	100.0	24	Voc Pkzoo
00213	0.0887	100.0	20	Shimoga	00297	0.0916	100.0	10	Mangalore
00224	0.0896	75.0	20	Vadodara	00189	0.0917	100.0	22	Mysore
00211	0.0900	100.0	21	Nagpur	00292	0.0936	100.0	11	Visakapat
00261	0.0916	100.0	16	Mysore	00293	0.0936	100.0	11	Visakapat
00294	0.0916	100.0	10	Mangalore	00254	0.0960	100.0	17	Visakapatnam
00296	0.0916	100.0	10	Mangalore	00280	0.0995	100.0	13	Shimoga
00291	0.0936	100.0	11	Visakapatnam	00226	0.1003	100.0	19	Bhilai
00127	0.0974	100.0	27	Madras	00098	0.1024	100.0	30	Jodhpur
00205	0.0983	100.0	21	Bhilai	00287	0.1039	100.0	12	Bhilai
00072	0.0989	100.0	32	Jodhpur	00302	0.1113	100.0	9	Visakapatnam
00160	0.1024	100.0	24	Junagadh	00315	0.1178	100.0	5	Bhilai
00286	0.1039	100.0	12	Bokaro	00328	0.1211	100.0	0	Bhilai
00288	0.1039	100.0	12	Bhilai					
00303	0.1113	100.0	9	Madras					
00304	0.1113	100.0	9	Visakapatnam					
00305	0.1113	100.0	9	Visakapatnam					
00314	0.1158	100.0	5	Bhilai					
00313	0.1178	100.0	5	Bhilai					
00217	0.1191	100.0	20	Visakapatnam					
00289	0.1236	100.0	12	Bhilai					

The use of possible pairing for each female that can be used for breeding is summarized in table 14.6 would ensure the maintenance of genetic viability without addition of new founder animals. Pairings which produced offspring with no inbreeding coefficient and minimal kinship values were used. The remaining mating choices were rejected.

Table 14.6 : Mating recommendations for the captive Bengal tiger population in Indian zoos

ID	Location	Sex	Breed With
00210	Indore	F	00298, 00308, 00321, 00301, 00311, 00327, 00325, 00324, 00248, 00255, 00257
00249	Hyderabad	F	00298, 00308, 00321, 00301, 00311, 00327, 00325, 00324, 00248, 00255, 00256, 00257
00265	Bilaspur	F	00298, 00308, 00321, 00301, 00311, 00327, 00325, 00324, 00248, 00255, 00256, 00257
00266	Bilaspur	F	00298, 00308, 00321, 00301, 00311, 00327, 00325, 00324, 00248, 00255, 00256, 00257
00277	Itanagar	F	00298, 00308, 00321, 00301, 00311, 00327, 00325, 00324, 00248, 00255, 00256, 00257
00283	Hyderabad	F	00298, 00308, 00321, 00301, 00311, 00327, 00325, 00324, 00248, 00255, 00256, 00257
00290	Borivilli	F	00298, 00308, 00321, 00301, 00311, 00327, 00325, 00324, 00248, 00255, 00256, 00257
00300	Borivilli	F	00298, 00308, 00321, 00301, 00311, 00327, 00325, 00324, 00248, 00255, 00256, 00257
00307	Delhi	F	00298, 00308, 00321, 00301, 00311, 00327, 00325, 00324, 00248, 00255, 00256, 00257
00309	Darjeelin	F	00298, 00308, 00321, 00301, 00311, 00327, 00325, 00324, 00248, 00255, 00256, 00257
00316	Vanvihar	F	00298, 00308, 00321, 00301, 00311, 00327, 00325, 00324, 00248, 00255, 00256, 00257
00317	Vanvihar	F	00298, 00308, 00321, 00301, 00311, 00327, 00325, 00324, 00248, 00255, 00256, 00257
00318	Nandankan	F	00298, 00308, 00321, 00301, 00311, 00327, 00325, 00324, 00248, 00255, 00256, 00257
00322	Nainital	F	00298, 00308, 00321, 00301, 00311, 00327, 00325, 00324, 00248, 00255, 00256, 00257
00323	Mysore	F	00298, 00308, 00321, 00301, 00311, 00327, 00325, 00324, 00248, 00255, 00256, 00257
00326	Mysore	F	00298, 00308, 00321, 00301, 00311, 00327, 00325, 00324, 00248, 00255, 00256, 00257

SPECIES UPDATE DATA

Species Update Data - Red Panda *((Ailurus fulgens fulgens)*

Sl. No.	Home Name and Transponder No.	National Studbook No.	International Studbook No.	Sex	Sire	Dam	Birth Date	Location	Date	Event	Remarks
1.	Nidhi 6836 14 D	00067		Female	00059	00058	13 Jun 2009	Gangtok	13 Jun 2009	Birth	
2.	Sonam 6 B 711 CA	00068		Male	00059	00062	2 Jul 2009	Gangtok	2 Jul 2009	Birth	
3.		00069		?	00059	00058	3 Jun 2010	Gangtok	3 Jun 2010	Birth	
4.		00070		?	00059	00062	20 Jun 2010	Gangtok	20 Jun 2010	Birth	
5.		00071		?	00059	00062	20 Jun 2010	Gangtok	20 Jun 2010	Birth	
6.	Durga 00062E087C	00072		Male	980121*	970003*	18 Dec 2002	Auckland Darjeeling	Capture Transfer	18 Dec 2002 9 Oct 2010	
7.	Samridhi 981098102055973	00073		Female	00061	00057	6 Jul 2008	Darjeeling	Birth	6 Jul 2008	
8.		00074		Male	00061	00057	6 Jul 2008	Darjeeling	Birth Death	6 Jul 2008 12 Jan 2009	
9.	Janaki 0006B7428B	00075		Female	00061	00057	22 Jun 2010	Darjeeling	Birth	22 Jun 2010	
10.	Ram 0006B82659	00076		Male	00061	00057	22 Jun 2010	Darjeeling	Birth	22 Jun 2010	
11.	00077			Male	00064	00073	25 Jun 2011	Darjeeling	Birth Death	25 Jun 2011 3 Jul 2011	

** Local ID at Auckland Zoo*

Species Update Data – Snow leopard (*Uncia uncia*)

Sl. No.	Home Name and Transponder No.	National Studbook No.	International Studbook No.	Sex	Sire	Dam	Birth Date	Location	Date	Event	Remarks
1.	Sujan Rani 0006B72F94	00026	2226	Female	00007	00015	8-Apr-2000	Darjeeling Nainital	Birth Transfer Death	8-Apr-2000 23-Dec-2004 21 Apr 2010	
2.	Subhash 00-0617-C8C5	00035	2404	Male	00014	00015	8-Jun-2002	Darjeeling Kufri	Birth Transfer	8-Jun-2002 31-Dec-2004	
3.	Dev 00-0617-D41B	00039	2402	Male	00014	00009	29-Mar-2003	Darjeeling Nainital	Birth Transfer Death	29-Mar-2003 23-Dec-2004 12 Mar 2009	
4.	Uncub5	00049		F	00016	00028	18-Apr-2009	Darjeeling	Birth Death	18-Apr-2009 7 Sep 2009	
5.	Uncub6	00050		F	00016	00028	18-Apr-2009	Darjeeling	Birth Death	18-Apr-2009 29 Aug 2009	
6.	Uncub7	00051		F	00016	00028	18-Apr-2009	Darjeeling	Birth Death	18-Apr-2009 2 Aug 2009	

Species Update Data - Tibetan Wolf *(Canis lupus chanco)*

Sl. No.	Home Name and Transponder No.	National Studbook No.	International Studbook No.	Sex	Sire	Dam	Birth Date	Location	Date	Event	Remarks
1.	Parbati 00-0611-683C	00010		F	Unk	Unk	Unk	Darjeeling	??? 5 Jul 2009	Birth Death	
2.	Tshakee	00050		F	00031	00038	2 Apr 2004	Darjeeling	2 Apr 2004	Birth	
3.	Dolma	00051		F	00031	00038	2 Apr 2010	Darjeeling	2 Apr 2010	Birth	
4.	Yankee	00052		F	00031	00038	2 Apr 2010	Darjeeling	2 Apr 2010	Birth	
5.	Danny	00053		M	00031	00044	14 Apr 2010	Darjeeling	14 Apr2010	Birth	

Species Update Data – Clouded Leopard *(Neofelis nebulosa)*

Sl. No.	Home Name and Transponder No.	National Studbook No.	International Studbook No.	Sex	Sire	Dam	Birth Date	Location	Date	Event	Remarks
1.	Badal 0006B7391D	00001		Male	Wild	Wild	????	India Assam	Capture Transfer Death	1 Jul 1992 1 Jul 1992 3 Sep 2010	
2.	CLO-1 Nandan 0006B73987	00002		Male	Wild	Wild	~1992	India Sepahijala	Capture Transfer	10 Feb 1996 10 Feb 1996	
3.	CLO-2 Tazu 0006B7E31B	00004		Male	Wild	Wild	~1994	India Sepahijala	Capture Transfer	25 Nov 1997 25 Nov 1997	
4.	CLO-3 Shilpi	00005		Female	Wild	Wild	????	India Sepahijala	Capture Transfer Death	9 Jun 2000 9 Jun 2000 30 Jul 2006	
5.	CLO-4 Ritul	00006		Female	Wild	Wild	~1996	India Sepahijala	Capture Transfer Death	28 Aug 2000 28 Aug 2000 4 Mar 2002	
6.	CLO-5 Mantu	00007		Male	Wild	Wild	~1997	India Sepahijala	Capture Transfer LTF	30 Oct 2000 30 Oct 2000 21 Jul 2001	
7.	CLO-6 Alam	00008		Male	Wild	Wild	~1996	India Sepahijala	Capture Transfer Death	19 May 2001 19 May 2001 28 Mar 2002	
8.	CLO-11 Sumita	00009		Female	Wild	Wild	~1996	India Sepahijala	Capture Transfer Death	19 May 2001 19 May 2001 1 Apr 2002	
9.	CLO-8 Minu	00010		Female	00002	00005	13 Jun 2001	Sepahijala	Birth Death	13 Jun 2001 5 Apr 2002	
10.	CLO-7 Khaled	00011		Male	00002	00005	13 Jun 2001	Sepahijala	Birth Death	13 Jun 2001 1 Jul 2001	
11.	CLO-9 Deshi 0006B8AC34	00012		Female	Wild	Wild	~1999	India Sepahijala	Capture Transfer	16 Jul 2001 16 Jul 2001	
12.	CLO-10 Ghaura 0006B7F07E	00013		Male	Wild	Wild	~1997	India Sepahijala	Capture Transfer	23 Jul 2001 23 Jul 2001	
13.	CLO-12 Unk1	00014		Unsexed	00004	00006	1 Mar 2002	Sepahijala	Birth Death	1 Mar 2002 1 Mar 2002	
14.	CLO-13 Unk2	00015		Unsexed	00004	00006	1 Mar 2002	Sepahijala	Birth Death	1 Mar 2002 3 Mar 2002	
15.	Raja 0006B71CE9	00016		Male	Wild	Wild	????	India Assam	Capture Transfer Death	4 Mar 2002 4 Mar 2002 18 Oct 2010	

Sl. No.	Home Name and Transponder No.	National Studbook No.	International Studbook No.	Sex	Sire	Dam	Birth	Location	Date	Event	Remarks
16.	CLO-14 Supriya	00017		Female	00004	00005	19 Jul 2002	Sepahijala	Birth Death	19 Jul 2002 29 Aug 2002	
17.	CLO-16 Rehana 0006B8A0B6	00018		Female	00004	00005	4 May 2003	Sepahijala	Birth	4 May 2003	
18.	CLO-17 Subash	00019		Male	00004	00005	4 May 2003	Sepahijala	Birth Death	4 May 2003 30 Jul 2003	
19.	CLO-15 Reshmi 0006B887B1	00020		Female	00004	00005	4 May 2003	Sepahijala	Birth	4 May 2003	
20.	CLO-18 Siddik 0006B8AEFC	00021		Male	Wild	Wild	????	India Sepahijala	Capture Transfer Death	23 Apr 2004 23 Apr 2004 29 Feb 2008	
21.	CLO-19 Rani	00022		Female	Wild	Wild	????	India Sepahijala	Capture Transfer LTF	24 May 2004 24 May 2004 22 Sep 2007	
22.	CLO-20 Ashok	00023		Male	00013	00005	27 Mar 2005	Sepahijala	Birth Death	27 Mar 2005 23 Sep 2005	
23.	CLO-21 Priti 0006B886C0	00024		Female	00013	00005	27 Mar 2005	Sepahijala Darjeeling	Birth Transfer	27 Mar 2005 27 Mar 2009	
24.	CLO-22 Zimmi 0006B883AC	00025		Male	00013	00005	27 Mar 2005	Sepahijala	Birth	27 Mar 2005	
25.	CLO-24 Pallabi 0006B8958A	00027		Female	00002	00020	24 Apr 2006	Sepahijala	Birth	24 Apr 2006	
26.	CLO-23 Meera Kumari 0006B7F06A	00028		Female	00002	00020	24 Apr 2006	Sepahijala	Birth	24 Apr 2006	Sex and name changed
27.	CLO-25 Rahul 0006B899A8	00029		Male	00004	00012	13 May 2006	Sepahijala	Birth	13 May 2006	
28.	28002 CLO-26 Nibash 0006B88A82	00030		Male	00002	00018	29 May 2006	Sepahijala Darjeeling	Birth Transfer	29 May 2006 22 Mar 2009	
29.	CLO-27 Parul 0006B8836	00032		Female	00002	00018	29 May 2006	Sepahijala	Birth	29 May 2006	
30.	CLO-28 Prativa 000B73C0D	00033		Female	00004	00022	19 Mar 2007	Sepahijala	Birth	19 Mar 2007	
31.	CLO-29 Manmohan CLO-30 Mayabati	00034 00035		Male Female	00013 00013	00020 00020	12 Mar 2008 12 Mar 2008	Sepahijala Sepahijala	Birth Birth	12 Mar 2008 12 Mar 2008	

Species Update Data – Hoolock Gibbon (*Hoolock hoolock*)

Sl. No.	Home Name and Transponder No.	National Studbook No.	International Studbook No.	Sex	Sire	Dam	Birth Date	Location	Date	Event	Remarks
1.	Toram	00044		?	00022	00023	5 Oct 2008	Itanagar	5 Oct 2008	Birth	
2.	Daoli	00045		?	Unk	00038	26 Sep 2009	Itanagar	26 Sep 2009	Birth	

Species Update Data – One horned Rhinoceros (*Rhinoceros unicornis*)

Sl. No.	Home Name and Transponder No.	National Studbook No.	International Studbook No.	Sex	Sire	Dam	Birth Date	Location	Date	Event	Remarks
1.	Nandan 098102055200	47		Male	Wild	Wild	~1977	India Assam Nandankanan	Capture Transfer Transfer	~ 1977 22/08/1977 29/11/1979	

Species Update Data – Indian bison – Gaur (Bos gaurus)

Sl. No.	Home Name and Transponder No.	National Studbook No.	International Studbook No.	Sex	Sire	Dam	Birth Date	Location	Date	Event	Remarks
1.	**M00055** Madhuri **CZA/CBO158** Ear notch	00018		F	00008	00009	22-Mar-1996	Mysore	22-Mar-1996	Birth	
2.	**M00056** Meena **CZA/CBO156** Ear notch	00026		Female	00008	00018	16-Mar-1997	Mysore	16-Mar-1997	Birth	
3.	M00060 Sundari CZA/CBO154	00031		F	00008	00018	7-Mar-1999 25 Sep 2009	Mysore	7-Mar-1999	Birth Death	
4.	M00090 Laara CZA/CBO147 V-shaped notch	00034		Male	00022	00023	9-May-2000	Mysore	9-May-2000	Birth	
5.	M00091 Rose CZA/CBO150 V-shaped notch	00035		Female	00025	00018	12-Aug-2000	Mysore	12-Aug-2000	Birth	
6.	M00092 Jasmine CZA/CBO151	00036		Female	00025	00021	24-Aug-2000	Mysore	24-Aug-2000	Birth	

Sl. No.	Home Name and Transponder No.	National Studbook No.	International Studbook No.	Sex	Sire	Dam	Birth Date	Location	Date	Event	Remarks
7.	M00674 Bhuvan CZA/CBO149	00049		M	25	00009	9-Jan-2003	Mysore	9-Jan-2003 27 Jun 2008	Birth Death	
8.	M00057 Chetan CZA/CBO155 Ear notch	00051		Male	00025	00026	23-Mar-2003	Mysore	23-Mar-2003	Birth	
9.	M00093 Kalpana CZA/CBO152 V-shaped notch	00053		Female	00034	00036	25-Aug-2003	Mysore	25-Aug-2003	Birth	
10.	M00094 Vipin CZA/CBO148 V-shaped notch	00055		Male	00025	00018	1-Oct-2003	Mysore	1-Oct-2003	Birth	
11.	M00058 Amith CZA/CBO157	00057		Female	00025	00009	14-Apr-2004	Mysore	14-Apr-2004	Birth	
12.	M00095 Akila CZA/CBO153 V-shaped notch	00058		Female	00034	00035	7-May-2004	Mysore	7-May-2004	Birth	
13.	M00059 Violaine CZA/CBO144 Ear notch	00065		Female	00025	00009	23-Mar-2005	Mysore	23-Mar-2005	Birth	
14.	M00061 Pretam CAZ/CBO148 Ear notch	00070		Male	00025	00009	17-Feb-2006	Mysore	17-Feb-2006	Birth	
15.	M00062 Anubhav CZA/CBO146 Ear notch	00072		Male	00025	00009	11-May-2006	Mysore	11-May-2006	Birth	
16.	M00096 Sarita CZA/CBO145 V-shaped notch	00073		Female	00025	00018	23-May-2006	Mysore Junagadh	23-May-2006 25 Feb 2011	Birth Transfer	
17.	M00063 Sheshan CZA/CBO159 Ear notch	00079		Male	00025	UNK	14-Feb-2007	Mysore Junagadh	14-Feb-2007 25 Feb 2011	Birth Transfer	
18.	M00681 Aditya	00080		M	00034	00057	3-Jun-2007	Mysore Ranchi	3-Jun-2007 15 Jul 2009	Birth Transfer	

Sl. No.	Home Name and Transponder No.	National Studbook No.	International Studbook No.	Sex	Sire	Dam	Birth Date	Location	Date	Event	Remarks
19.	M00682 Ashoka	00081		Male	00025	00065	24-Jun-2007	Mysore Chatbir	24-Jun-2007 19 Sep 2008	Birth Transfer	
20.	M00064 Gowri 0063B72E5	00082		Female	00025	00018	1-Sep-2007	Mysore	1-Sep-2007	Birth	
21.	M00097 Siddhu 00063B0C20	00083		Male	00034	00031	25-Sep-2007	Mysore	25-Sep-2007	Birth	
22.	M00098 Harsha 00063B0314 CZA/CBO141	00084		Male	00034	00053	25-Sep-2007	Mysore	25-Sep-2007	Birth	
23.	M00684 Prakash 00-063B-1896	00087		Male	Unk	Unk	13-Mar-2008	Mysore Pune	13-Mar-2008 21-Sep-2009	Birth Transfer	
24.	M00683 Ragini CZA/CBO142	00089		Female	00034	00035	9-Jan-2008	Mysore Ranchi	9-Jan-2008 15 Jul 2009	Birth Transfer	
25.	M00685 Hamsa 00-063B-3EFB	00092		Female	Unk	Unk	30-Apr-2008	Mysore Pune	30-Apr-2008 21-Sep-2009	Birth Transfer	
26.		00093		?	00047	00007	20-Jun-2009	Bannerghata	20-Jun-2009	Birth	
27.	Beema	00094		M	WILD	WILD	????	India Mysore	~19 Mar 1987 19 Mar 1987 21 Jul 1994	Capture Transfer Death	
28.	M00100 Sanju	00095		M	00025	00018	5 Mar 2004	Mysore	5 Mar 2004	Birth	
29.		00097		M	00013	00030	26 Jun 2006	Bannerghata	26 Jun 2006	Birth	
30.	100174 Suba	00098		F	00028	00037	3 Jan 2007	Chennai	3 Jan 2007	Birth	
31.	Thunge calf	00099		M	00013	00021	2 Feb 2007	Bannerghata	2 Feb 2007	Birth	
32.	Gange calf	00100		M	00013	00030	4 Jun 2007	Bannerghata	4 Jun 2007	Birth	
33.	M00065 Likitha	00101		F	00057	00065	20 Dec 2008	Mysore	20 Dec 2008	Birth	
34.	M00099 Punith 00-063AC-6F7 CZA/CBO161	00102		M	00034	00053	25 Dec 2008	Mysore	25 Dec 2008	Birth	
35.	M00066 Ravi 0006CC17DA CZA/CBO 163	00103		M	00057	00026	21 Feb 2009	Mysore	21 Feb 2009	Birth	
36.	M00686 Ramya 00-06B7-5085 CZA/CBO-164	00104		F	00034	00031	23 Apr 2009	Mysore	23 Apr 2009 8 Jan 2010	Birth Death	

Sl. No.	Home Name and Transponder No.	National Studbook No.	International Studbook No.	Sex	Sire	Dam	Birth Date	Location	Date	Event	Remarks
37.	M00103 Sushma 0006CD2D39 CZA/CB0165	00105		F	00034	00038	4 Jul 2009	Mysore Trivandrum	4 Jul 2009 25 Aug 2011	Birth Transfer	
38.	M00104 Gangubai 0006CBDBE9 CZA/CBO167	00106		F	00034	00035	22 Jul 2009	Mysore	22 Jul 2009	Birth	
39.	M00105 Raksha 0006CC29E8 CZA/CBO168	00107		F	00034	00036	4 Aug 2009	Mysore	4 Aug 2009	Birth	
40.	Kaveri calf	00108		F	00047	00074	10 Aug 2009	Bannerghata	10 Aug 2009	Birth	
41.	M00067 Narasimha 0006B74F4F CZA/CBO 17	00109		M	00051	00026	22 Nov 2009	Mysore	22 Nov 2009	Birth	
42.	M00106 Mahadeva 0006B75B54 CZA/CBO174	00110		M	00055	00073	2 Dec 2009	Mysore	2 Dec 2009	Birth	
43.	M00107 Venki 0006CC3690 CZA/CBO176	00111		M	00055	00053	19 Dec 2009	Mysore	19 Dec 2009 4 Oct 2010	Birth Death	
44.	M00068 Pruthvi 0006CC30BE CZA/CBO177	00112		M	00057	00018	26 Dec 2009	Mysore	26 Dec 2009	Birth Death	
45.	M00069 Shivraj 0006CBF2CC CZA/CBO178	00113		M	00057	00082	2 Feb 2010	Mysore	2 Feb 2010	Birth Death	
46.	M00070 Raghavnedra 0006CBFEA4 CZA/CBO159	00114		M	00051	00061	14 Feb 2010	Mysore	14 Feb 2010 19 Dec 2010	Birth Death	
47.	100178 Cauvery	00115		F	00028	00062	25 Apr 2010	Chennai	25 Apr 2010	Birth	
48.	M00108 Anjali 0006CD0621	00116		F	00055	00058	13 Jun 2010	Mysore	13 Jun 2010	Birth	

Sl. No.	Home Name and Transponder No.	National Studbook No.	International Studbook No.	Sex	Sire	Dam	Birth Date	Location	Date	Event	Remarks
49.	M00109 Anitha 0006CBFDBG CZA/CBO180	00117		F	00055	00053	6 Jul 2010	Mysore	6 Jul 2010	Birth	
50.	M00110 Yathish 0006BD688	00118		M	00055	00120	12 Aug 2010	Mysore	12 Aug 2010 21 Apr 2011	Birth Death	
51.	100179	00119		M	00028	00098	12 Aug 2010	Chennai	12 Aug 2010 27 Aug 2010	Birth Death	
52.	M00111 Darshini 0006CBFA33 CZA/CBO184	00120		F	00055	Unk	17 Nov 2010	Mysore	17 Nov 2010	Birth	
53.	M00087 Vishnu 0006CBE987 CZA/CBO185	00121		M	00057	00082	14 Dec 2010	Mysore	14 Dec 2010	Birth	
54.	M00086 Ajith CZA/CBO187	00122		M	00057	00026	3 Jan 2011	Mysore	3 Jan 2011	Birth	
55.	M00112 Babu CZA/CBO188	00123		M	00055	00073	8 Jan 2011	Mysore	8 Jan 2011	Birth	
56.	M00085 Priyanka	00124		F	00005	00065	25 Jan 2011	Mysore	25 Jan 2011	Birth	
57.	M00088 Akansha CZA/CBO189	00125		F	00057	00016	8 Feb 2011	Mysore	8 Feb 2011	Birth	
58.	100180	00126		F	00028	00062	6 Apr 2011	Chennai	6 Apr 2011	Birth	
59.	M00747 Bhim 956000002157015 CB0/CZA190	00127		M	00034	00058	5 Jun 2011	Mysore	5 Jun 2011	Birth	

Species Update Data – Dhole – Asiatic wild dog (Cuon alpinus)										
Sl. No.	**Home Name and Transponder No.**	**National Studbook No.**	**Sex**	**Sire**	**Dam**	**Birth Date**	**Location**	**Date**	**Event**	**Remarks**
1.	Unamed	00001	Female	Unk	Unk	2-Dec-1999	Chennai Mysore	2-Dec-1999 19-Dec-2003	Birth Transfer	Deleted from the national studbook
2.	Mohan	00002	Male	00055	00057	2 Dec 1999	Chennai	2 Dec 1999 23 Feb 2005	Birth Death	
3.	Viji	00003	Female	00055	00057	9 Dec 1998	Chennai	9 Dec 1998 17 Nov 2004	Birth Death	
4.	Uname1	00009	Male	Unk	Unk	18-Oct-2002	Chennai Mysore	18-Oct-2002 19-Dec-2003	Birth Transfer	Deleted from the national studbook
5.	Valli	00020	Female	00055	00057	2 Dec 1999	Chennai Mysore	2 Dec 1999 21 Dec 2009	Birth Transfer	
6.	ZSB40 Sivasankar	00021	Male	16	14	19-Aug-2006	Chennai	19-Aug-2006 11 Sep 2007	Birth Death	
7.	Mani	00022	Male	00059	00060	18 Oct 2002	Chennai Mysore	18 Oct 2002 19 Dec 2003 9 Aug 2011	Birth Transfer Death	
8.	AAZP47 100104 Ashwin 00065EB22D	00032	Male	00017	00012	14-Nov-2007	Chennai	14-Nov-2007 3 Sep 2008	Birth Death	
9.	AAZP48 Ramu 00061126AC	00033	Male	00017	00012	14-Nov-2007	Chennai	14-Nov-2007 10 Oct 2008	Birth Death	
10.	AAZP49 100105	00034	Female	00017	00012	14-Nov-2007	Chennai	14-Nov-2007 10 Jul 2009	Birth Death	
11.	AAZP50 100106	00035	Female	00017	00012	14-Nov-2007	Chennai	14-Nov-2007 3 Jun 2010	Birth Death	
12.	AAZP53	00036	Female	00016	00014	6-Jan-2008	Chennai	6-Jan-2008 20 Oct 2008	Birth Death	
13.	M00324 AAZP51	00037	Male	00016	00014	6-Jan-2008	Chennai Mysore	6-Jan-2008 9 Oct 2009	Birth Transfer	
14.	AA;ZP52	00038	Male	00016	00014	6-Jan-2008	Chennai	6-Jan-2008 25 Feb 2010	Birth Death	

Sl. No.	Home Name and Transponder No.	National Studbook No.	Sex	Sire	Dam	Birth Date	Location	Date	Event	Remarks
15.	AAZP54	00039	Female	00016	00014	6-Jan-2008	Chennai	6-Jan-2008 3 Oct 2010	Birth Death	
16.	M00325 100109 AAZP55 Lekshmi 0006113ADB	00040	Female	00016	00014	6-Jan-2008	Chennai Mysore	6-Jan-2008 9 Oct 2009	Birth	
17.	100110 AAZP56	00041	Female	00016	00014	6-Jan-2008	Chennai	6-Jan-2008 22 Jan 2010	Birth Death	
18.	Anu	00042	F	Wild	Wild	~ 1985	India Chennai	~14 Feb 1985 14 Feb 1985 23 Aug 1994	Capture Transfer Death	
19.	Gopal/Asok	00043	M	Wild	Wild	~ 1985	India Chennai	~14 Feb 1985 14 Feb 1985	Capture Transfer	
20.	Krishna	00044	M	Wild	Wild	~ 1985	India Chennai	~14 Feb 1985 14 Feb 1985 ~ 1990	Capture Transfer ltf	
21.		00045	F	Unk	00042	~1987	Chennai Hyderabad	~1987 ~ 1990 25 Nov 1992	Birth Transfer Death	
22.	Suresh	00046	M	00043	00042	23 Dec 1987	Chennai	23 Dec 1987 21 Jan 1996	Birth Death	
23.	Alli/Ambika	00047	F	Unk	00042	~1989	Chennai	~1989 23 Aug 1994	Birth Death	
24.	Arjun	00048	M	Unk	00042	~1989	Chennai	~1989 25 Nov 1992	Birth Death	
25.	Raghavan/Sankar	00049	M	00043	00042	24 Nov 1990	Chennai	24 Nov 1990 5 Mar 2001	Birth Death	
26.	Sheela	00050	F	00046	00042	15 Nov 1991	Chennai	15 Nov 1991 7 Jun 1998	Birth Death	
27.	Shilpa	00051	F	00046	00042	15 Nov 1991	Chennai	15 Nov 1991 2 Apr 1998	Birth Death	
28.	Abhitha	00052	F	Unk	00042	~1992	Chennai	~1992 10 Nov 1994	Birth Death	
29.	Radha	00053	F	Unk	00042	~1992	Chennai	~1992 20 Nov 1994	Birth Death	

Sl. No.	Home Name and Transponder No.	National Studbook No.	Sex	Sire	Dam	Birth Date	Location	Date	Event	Remarks
30.	Subu	00054	M	00043	00042	3 Jan 1994	Chennai	3 Jan 1994 31 Dec 1996	Birth Death	
31.	Sekar	00055	M	00043	00042	3 Jan 1994	Chennai	3 Jan 1994 18 May 2002	Birth Death	
32.	Rathnam	00056	M	00043	00042	3 Jan 1994	Chennai	3 Jan 1994 14 Jul 2001	Birth Death	
33.	Ashwini	00057	F	Wild	Wild	????	India Chennai	~28 Mar 1996 28 Mar 1996 17 Mar 2002	Capture Transfer Death	
34.	Rohini	00058	F	00055	00057	30 Nov 1996	Chennai	30 Nov 1996 5 May 1999	Birth Death	
35.	Balu	00059	M	00055	00057	9 Dec 1998	Chennai Guindy	9 Dec 1998 20 Jan 2000	Birth Transfer	
36.	Amudha	00060	F	00055	00057	9 Dec 1998	Chennai Guindy	9 Dec 1998 20 Jan 2000	Birth Transfer	
37.		00061	?	00055	00057	2 Dec 1999	Chennai	2 Dec 1999 ????	Birth Death	
38.		00062	?	00055	00057	2 Dec 1999	Chennai	2 Dec 1999 ????	Birth Death	
39.		00063	?	00055	00057	2 Dec 1999	Chennai	2 Dec 1999 ????	Birth Death	
40.		00064	?	00055	00057	2 Dec 1999	Chennai	2 Dec 1999 ????	Birth Death	
41.		00065	M	00002	00003	28 Dec 2003	Chennai	28 Dec 2003 25 Feb 2005	Birth Death	
42.		00066	M	00016	00014	31 Dec 2005	Chennai	31 Dec 2005 29 Apr 2006	Birth Death	
43.		00067	F	00016	00014	31 Dec 2005	Chennai	31 Dec 2005 29 Apr 2006	Birth Death	
44.		00068	F	00016	00014	31 Dec 2005	Chennai	31 Dec 2005 29 Apr 2006	Birth Death	
45.		00069	F	00016	00014	31 Dec 2005	Chennai	31 Dec 2005 5 Jul 2006	Birth Death	

Sl. No.	Home Name and Transponder No.	National Studbook No.	Sex	Sire	Dam	Birth Date	Location	Date	Event	Remarks
46.		00070	?	00016	00014	31 Dec 2005	Chennai	31 Dec 2005 ~5 Jul 2006	Birth Death	
47.		00071	M	00017	00012	3 Jan 2007	Chennai	3 Jan 2007 4 Mar 2007	Birth Death	
48.		00072	M	00017	00012	3 Jan 2007	Chennai	3 Jan 2007 10 Mar 2007	Birth Death	
49.		00073	M	00017	00012	3 Jan 2007	Chennai	3 Jan 2007 10 Mar 2007	Birth Death	
50.		00074	F	00017	00012	3 Jan 2007	Chennai	3 Jan 2007 10 Mar 2007	Birth Death	
51.		00075	F	00017	00012	3 Jan 2007	Chennai	3 Jan 2007 4 Mar 2007	Birth Death	
52.	100111	00076	M	00017	00012	19 Dec 2008	Chennai	19 Dec 2008 22 Feb 2010	Birth Death	
53.	100112	00077	F	00017	00012	19 Dec 2008	Chennai	19 Dec 2008	Birth	
54.	100113	00078	F	00017	00012	19 Dec 2008	Chennai	19 Dec 2008	Birth	
55.	100114	00079	F	00017	00012	19 Dec 2008	Chennai	19 Dec 2008	Birth	
56.	100115	00080	F	00017	00012	19 Dec 2008	Chennai	19 Dec 2008	Birth	
57.	100116	00081	M	00017	00012	19 Dec 2008	Chennai	19 Dec 2008	Birth	
58.	100117	00082	M	00017	00012	19 Dec 2008	Chennai	19 Dec 2008	Birth	

Species Update Data – Indian bison – Gaur (Bos gaurus)											
Sl. No.	**Home Name and Transponder No.**	**National Studbook No.**	**International Studbook No.**	**Sex**	**Sire**	**Dam**	**Birth Date**	**Location**	**Date**	**Event**	**Remarks**
1.	Unnamed10	00010		F	Unk	Unk	25 Feb 1992	Mumbai	Birth Death	25 Feb 1992 4 Jan 2009	
2.	10046 Unnamed16	00021		F	Unk	Unk	19 Apr 2001	Mumbai	Birth Death	19 Apr 2001 18 Mar 2010	
3.	GPP8 Transponder No. CB/CZA/INDIA/07/1558	00032		F	Unk.	Unk.	15 April 2006		Birth	15 April 2006	D.O.B changed
4.	GPP2 Transponder No. CB/CZA/INDIA/07/1556	00036		M	Unk.	Unk.	10 May 2002	Darjeeling Kufri	Birth Transfer	10 May 2002 06 Nov 2011	Age at entry approx. 2 years.
5.	GPP7 Transponder No. CB/CZA/INDIA/07/1557	00047		M	Unk.	Unk.	~2001	Kolkata Darjeeling Death	Birth Transfer 7 Oct 2009	~2001 20 Jan 2004	Age at entry approx. 3 years. Sex changed from female to male. Birth place changed from Darjeeling to Kolkata
6.	GPP4 Transponder No. CB/CZA/INDIA/07/1553	00049		F	Unk.	Unk.	22 Feb 2007	Darjeeling	Birth Death	22 Feb 2007 12 Feb 2010	
7.	UNNAMED16	00055		M	Unk	Unk	22 April 2010	Darjeeling	Birth	22 April 2010	
8.	CZAINDIA/1557	00056		F	Unk	Unk	20 Feb 2005	Darjeeling Kufri	Birth Transfer	20 Feb 2005 06 Nov 2011	
9.	CZAINDIA/1579	00057		F	Unk	Unk	20 Feb 2005	Darjeeling Kufri	Birth Transfer	20 Feb 2005 06 Nov 2011	
10.	10008	00058		M	Unk	Unk	19 Apr 2001	Mumbai	Birth	19 Apr 2001	

Species Update Data - Asiatic lion *(Panthera leo persica)*

Sl. No.	Local ID, Home Name and Transponder No.	National Studbook No.	Sex	Sire	Dam	Birth Date	Location	Date	Event	Remarks
1.	10003 Anita 237	266	Female	Wild	Wild	????	Gir Sanctuary Junagadh Veermata	~ 1990 1-Mar-1990 19-Mar-1991 19 Jun 2010	Capture Transfer Transfer Death	
2.	10022 Navin 235	264	Male	Wild	Wild	~ 1988	Gir Sanctuary Junagadh Veermata	~ 1990 1-Mar-1990 19-Mar-1991 13-Feb-1997	Capture Transfer Transfer Death	
3.	10037	328	Male	264	266	8-Dec-1994	Veermata	8-Dec-1994 12-Dec-1994	Birth Death	
4.	10038 Jay	339	Male	264	266	3-Apr-1995	Veermata	3-Apr-1995 1-Feb-1996	Birth Death	
5.	10039 Vijay	340	Male	264	266	3-Apr-1995	Veermata	3-Apr-1995 28-Mar-1997	Birth Death	
6.	10040 Monica	341	Female	264	266	3-Apr-1995	Veermata	3-Apr-1995 30-Nov-1997	Birth Death	
7.	10041 Seeta	363	Female	264	266	1-Apr-1996	Veermata	1-Apr-1996 22-Sep-1996	Birth Death	
8.	10042 Geeta	364	Female	264	266	1-Apr-1996	Veermata	1-Apr-1996 29-Jan-1997	Birth Death	
9.	10036 Amar 27	476	Male	370	299	19-Jan-2000	Hyderabad Veermata	19-Jan-2000 23-Aug-2002 2 Oct 2007	Birth Transfer Death	
10.	M00148 Manthan 00-06B7-2942	645	Male	566	377	18-Feb-2008	Junagadh Mysore	18-Feb-2008 6 Mar 2011	Birth Transfer	
11.	M00149 Het 6830274	651	Female	564	585	20-Feb-2008	Rajkot Junagadh Mysore	20-Feb-2008 10-Jul-2009 6 Mar 2011	Birth Transfer Transfer	

Species Update Data - Nilgiri langur *(Trachypithecus johnii)*										
Sl. No.	**Local ID, Home Name and Transponder No.**	**National Studbook No.**	**Sex**	**Sire**	**Dam**	**Birth Date**	**Location**	**Date**	**Event**	**Remarks**
12.	100196 KANNAN	00012	M	Unk	Unk	17 May 1996	MADRAS	17 May 1996 25 Jul 2009	Birth Death	
13.	100194 KAVITHA	00013	F	Unk	00010	15 Jul 1996	MADRAS	15 Jul 1996	Birth	
14.	100195 KANNAHI	00014	F	Unk	00009	15 Jul 1996	MADRAS	15 Jul 1996	Birth	
15.	SELVI	00015	F	Unk	00009	13 Mar 1997	MADRAS HYDERABAD	13 Mar 1997 27 Sep 2007	Birth Transfer	
16.	GUGAN	00016	M	Unk	00010	21 Nov 1997	MADRAS	21 Nov 1997 25 Jun 2010	Birth Death	
17.	M00309 JANAVI1 0006B73849	00017	F	00036	00029	18 Apr 1999	MYSORE	18 Apr 1999	Birth	
18.	100197 RAVI	00019	M	00012	00009	2 Mar 2002	MADRAS	2 Mar 2002	Birth	
19.	100208 AAZP35 0006118EB2	00020	M	UNK	UNK	27 Jul 2002	GUINDY MADRAS	27 Jul 2002 27 Jul 2009	Birth Transfer	Status changed from wild born to captive born
20.	100198 NAGA BHUSH 0006B72EE7	00022	F	00012	00010	12 Dec 2002	MADRAS HYDERABAD	12 Dec 2002 28 Sep 2007	Birth Transfer	
21.	100199 AAZP 25	00023	F	00012	00013	4 Jan 2003	MADRAS	4 Jan 2003	Birth	
22.	100200 AAZP 26	00024	M	Unk	Unk	11 Feb 2004	MADRAS	11 Feb 2004	Birth	
23.	100201 AAZP 27	00025	F	Unk	Unk	11 Mar 2004	MADRAS	11 Mar 2004	Birth	
24.	100202 AAZP 28	00026	F	Unk	Unk	13 Jul 2004	MADRAS	13 Jul 2004	Birth	
25.	REGHU	00027	M	WILD	WILD	???	India Thiruvanan-thapuram	24 Sep 2004 24 Sep 2004	Capture Transfer	
26.	M00310 JEEVITHA JEEVAN 0006B73849	00028	M	00031	00030	4 Jun 2005	MYSORE	4 Jun 2005	Birth	Sex changed from female to male on 1 Jan 2011
27.	M00739 SONIYA	00029	F	WILD	WILD	~1997	India MYSORE	~21 Jun 1999 21 Jun 1999 25 Nov 2007	Capture Transfer Death	

Sl. No.	Local ID, Home Name and Transponder No.	National Studbook No.	Sex	Sire	Dam	Birth Date	Location	Date	Event	Remarks
28.	M00740 MENAKA	00030	F	WILD	WILD	~1997	India MYSORE	~21 Jun 1999 21 Jun 1999 2 Dec 2007	Capture Transfer Death	
29.	M00738 SANJAY	00031	M	WILD	WILD	~1997	India MYSORE	~21 Jun 1999 21 Jun 1999 15 Jun 2006	Capture Transfer Death	
30.	100203 AAZP 29	00032	F	Unk	Unk	10 Mar 2007	MADRAS	10 Mar 2007	Birth	
31.	10020 AAZP 30	00033	F	Unk	Unk	5 Apr 2007	MADRAS	5 Apr 2007	Birth	
32.	100205 AAZP32	00034	Unk	Unk	Unk	5 Feb 2009	MADRAS	5 Feb 2009	Birth	
33.	100206 AAZP33	00035	Unk	Unk	Unk	5 Jun 2009	MADRAS	5 Jun 2009	Birth	
34.	AAZP31	00037	F	Unk	Unk	25 Dec 2009	MADRAS	25 Dec 2009 5 March 2006	Birth Death	
35.	100192 Dasarathan	T1	M	WILD	WILD	~1982	INDIA MADRAS	~22 Dec 1984 22 Dec 1984 16 Jul 2005	Capture Transfer Death	
36.	100191 Kousalya	T2	F	WILD	WILD	~1982	INDIA MADRAS	~28 Oct 1985 28 Oct 1985 25 May 2005	Capture Transfer Death	
37.	Seetha	T3	F	T1	T2	16 Jul 1991	MADRAS NANDAN KANAN	16 Jul 1991 26 Feb 1995	Birth Transfer	
38.	UNK1	T4	F	WILD	WILD	???	INDIA MADRAS HYDERABAD	~24 Nov 1992 24 Nov 1992 26 Feb 1995	Capture Transfer Transfer	
39.	Raman	T5	M	T1	T2	6 Jul 1993	MADRAS GUINDY	6 Jul 1993 ???	Birth Transfer	
40.	Lakshman	T6	M	T1	T2	22 Dec 1993	MADRAS	22 Dec 1993 5 March 2000	Birth Death	

Sl. No.	Local ID, Home Name and Transponder No.	National Studbook No.	Sex	Sire	Dam	Birth Date	Location	Date	Event	Remarks
41.	UNK2	00044	M	T1	T2	26 Feb 1994	MADRAS	26 Feb 1994 9 May 1994	Birth Death	
42.	Valliappan	00045	M	WILD	WILD	???	INDIA MADRAS	~13 Jan 1994 13 Jan 1994 ~16 Oct 1995	Capture Transfer Death	
43.	Mallaiyappan	00046	M	WILD	WILD	???	INDIA MADRAS	~11 Jun 1994 11 Jun 1994 ~25 May 1998	Capture Transfer Death	
44.	UNK3	00047	M	WILD	WILD	???	INDIA MADRAS	~11 Jun 1994 11 Jun 1994 ~12 Jun 1994	Capture Transfer Death	
45.	Kalpana	00048	F	T1	T2	1 Jun 1995	MADRAS GUINDY	1 Jun 1995 ???	Birth Transfer	
46.	UNK4	00049	M	T1	T2	9 March 1995	MADRAS	9 March 1995 24 Aug 1995	Birth Death	
47.	UNK5	00050	F	00012	00010	???	OOTY MADRAS	??? 1 April 2001 26 May 2001	Birth Transfer Death	
48.	UNK6	00051	M	00012	T2	31 Jul 2002	MADRAS	31 Jul 2002 15 March 2005	Birth Death	
49.	100207	00052	M	WILD	WILD	~2006	INDIA MADRAS	~18 Jul 2009 18 Jul 2009		

Species Update Data - Lion tailed macaque (*Macaca silenus*)

Sl. No.	Local ID, Home Name and Transponder No.	National Studbook No.	Sex	Sire	Dam	Birth Date	Location	Date	Event	Remarks
1.	10028 Ram	245	M	239	238	13Jul 1981	Veermata	13Jul 1981 13Sep 1993	Birth Death	
2.	490001 10030	318	M	Unk	Unk	~Jul 1940ñ1m	Veermata Melbourne	~Jul 1940ñ1m 1 Dec 1940 1 Aug 1958	Birth Transfer Death	
3.	10031	319	M	Unk	Unk	15 Jul 1949	Veermata Melbourne	15 Jul 1949 1 Dec 1949 1 Jan 1959	Birth Transfer Death	
4.	490002 10032	320	F	Unk	Unk	15 Jul 1949	Veermata Melbourne	15 Jul 1949 1 Dec 1949 1 Jun 1964	Birth Transfer Death	
5.	490003 10033	321	F	Unk	Unk	~Jul 1949ñ1m	Veermata Melbourne	~Jul 1949ñ1m 1 Dec 1949 1 Jul 1964	Birth Transfer Death	
6.	10024 Kunda	322	F	WILD	WILD	~ 1969	India Veermata	1 Jan 1971 29 Nov 1971 17 Jul 1989	Capture Transfer Death	
7.	10027 Teena	323	F	WILD	WILD	~ 1973	India Veermata	~Jan 1976ñ1m 22 Nov 1976 11 Sep 1985	Capture Transfer Death	

RESEARCH OUTCOMES

Research Reports

1. Srivastav, A., Nigam. P., Chakraborty, D. and Nayak, A.K. (2009). National Studbook of Red Panda *(Ailurus fulgens)*. Wildlife Institute of India, Dehradun and Central Zoo Authority, New Delhi. (July, 2009).
2. Srivastav, A. and Nigam, P. (2009). Indian National Studbook of One horned rhinoceros *(Rhinoceros unicornis)*. Wildlife Institute of India, Dehradun and Central Zoo Authority, New Delhi. (August, 2009).
3. Srivastav, A. and Nigam. P. (2009). National Pedigree book of Tibetan wolf *(Canis lupus chanco)*. Wildlife Institute of India, Dehradun and Central Zoo Authority, New Delhi. (August, 2009).
4. Srivastav, A., Nigam, P., Chakraborty, D. and Nayak, A.K. (2009). Indian National Studbook of Snow Leopard *(Uncia uncia)*. Wildlife Institute of India, Dehradun and Central Zoo Authority, New Delhi. (August, 2009).
5. Srivastav, A. and Nigam. P. (2009). National Studbook of Clouded Leopard *(Neofelis nebulosa)*. Wildlife Institute of India, Dehradun and Central Zoo Authority, New Delhi. (December, 2009).
6. Srivastav, A. and Nigam. P. (2009). National Studbook of Hoolock Gibbon *(Hoolock hoolock)*. Wildlife Institute of India, Dehradun and Central Zoo Authority, New Delhi. (December, 2009).
7. Srivastav, A., Nigam. P., Chakraborty, D. and Nayak, A.K. (2010). National Studbook of Gaur *(Bos gaurus)*. Wildlife Institute of India, Dehradun and Central Zoo Authority, New Delhi. (April 2010).
8. Srivastav, A. and Nigam, P. (2010). National Studbook of Asiatic wild dog *(Cuon alpines)*. Wildlife Institute of India, Dehradun and Central Zoo Authority, New Delhi. (June 2010).
9. Srivastav, A. and Nigam, P. (2010). National Studbook of Wild ass *(Equus hemionus khur)*. Wildlife Institute of India, Dehradun and Central Zoo Authority, New Delhi. (August 2010).
10. Srivastav, A. and Nigam, P. (2010). National Studbook of Bhutan grey peacock pheasant *(Polyplectron bicalcaratum)*. Wildlife Institute of India, Dehradun and Central Zoo Authority, New Delhi. (November 2010).
11. Srivastav, A., Nigam, P., Malviya, M. and Tyagi, P.C. (2011). Indian National Studbook of Asiatic Lion *(Panthera leo persica)*. Wildlife Institute of India, Dehradun and Central Zoo Authority, New Delhi. (April, 2011).
12. Malviya. M., Srivastav, A., Nigam. P, and Tyagi. P.C., (2011). National Studbook of Nilgiri Langur *(Trachypithecus johnii)*. Wildlife Institute of India, Dehradun and Central Zoo Authority, New Delhi. (May, 2011).
13. Malviya, M., Srivastav, A., Nigam, P. and Tyagi, P.C. (2011). National Studbook of Lion Tailed Macaque *(Macaca silenus)*. Wildlife Institute of India, Dehradun and Central Zoo Authority, New Delhi. TR-2011/004. (September, 2011).
14. Srivastav, A., Malviya, M., Tyagi, P.C. and Nigam, P. (2011). Indian National Studbook of Bengal Tiger *(Panthera tigris tigris)*. Wildlife Institute of India, Dehradun and Central Zoo Authority, New. Delhi. TR-2011/006. (December, 2011).

Papers Presented in Conferences/Seminars

Srivastav, A., and P. Nigam, (2010). Managing Captive Populations Using Pedigree Data: A Case Study of One-horned Rhinoceros. Annual Research Seminar, Wildlife Institute of India (16th September 2010).

Malviya, M., Srivastav, A., Nigam, P., and P.C. Tyagi (2011). Management of captive populations using studbooks: lessons learnt and the way forward. Internal Research Seminar, Wildlife Institute of India (10th October 2011).

Malviya, M., Srivastav, A., Nigam, P. and P.C. Tyagi (2011). Demographic and genetic profiling of captive red panda (Ailurus fulgens fulgens). National Congress on Wildlife Health and Forensics & Annual Convention of AIZWV organized by Centre for Wildlife Forensic and Health. M.P.P.C.V.V, Jabalpur in collaboration with AIZWV. (15th -16th September 2011).

CAPACITY ENHANCEMENT

30th November to 4th December 2010

Dr. Anupam Srivastav and Ms. Manjari Malviya attended training workshop on SPARKS organized by Central Zoo Authority, New Delhi and International Species Inventory System, Eagan, MN 55121-1170 USA at Guwahati.

18th - 23rd October 2010

Ms. Manjari Malviya attended Training workshop on ARKS organized by Central Zoo Authority, New Delhi and International Species Inventory System, Eagan, MN 55121-1170 USA at Gurgaon.

10th - 15th February 2009

Dr. Anupam Srivastav attended Training workshop on ARKS organized by Central Zoo Authority, New Delhi and International Species Inventory System, Eagan, MN 55121-1170 USA at Chandigarh

21st - 24th February 2008

Dr. Anupam Srivastav attended International Conference 'India's Conservation Breeding Initiative' organized by Central Zoo Authority, New Delhi at New Delhi.

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